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REPORT OF THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM-1971--ETC(U)
MAY 74 P A MITCHELL
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NAVAL OCEANOGRAPHIC OFFICE SPECIAL PUBLICATION 70 (71)

REPORT OF THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM—1971

MAY 1974

DEPARTMENT OF THE NAVY
WASHINGTON, D.C. 20390

This report of the last Arctic, The last of this series, was conducted

ABSTRACT

The ice program conducted during 1971 in the North American Arctic by the Naval Oceanographic Office is presented. Methods of collection and dissemination of ice data, ice forecasting, forecast verification, and interpretation of satellite ice observations are discussed. Sea ice distribution in the eastern Arctic was generally normal or slightly heavier than normal. Expected dates for escorted and unescorted entry into 5 selected eastern Arctic ports were forecasted. Conditions for escorted entry into 3 of these ports occurred as predicted. Escorted entry at the 2 remaining ports occurred 1 to 9 days later than forecast. Conditions for unescorted entry also occurred as predicted at 3 of these ports. Unescorted entry was possible 6 days later than forecast at one port and 20 days earlier than forecast at the fifth port. Ice conditions in the western Arctic were heavier than normal for the third consecutive year, especially in the Bering Sea during spring. Ice conditions, based on aerial and satellite data in the eastern and western sectors of the Arctic and data observed over the Arctic Basin during 2 BIRDS EYE missions, are shown graphically in separate appendixes.

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(10) PETER A. MITCHELL

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FOREWORD

This annual report, the twentieth and last of a series, summarizes the ice program conducted during 1971 by the Naval Oceanographic Office principally in support of Military Sealift Command resupply operations in the eastern Arctic and Commander Alaskan Sea Frontier in the western Arctic. Extensive ice data acquired by aerial reconnaissance, icebreakers, and satellite photography were used to prepare ice forecasts. Satellite photography has proven in recent years to be an invaluable tool for supplementing aerial reconnaissance and to provide continuous coverage enabling the forecaster to observe movement of ice edges, opening and closing of leads, and formation of other significant ice-related features. These data, together with historical information, make possible a comprehensive accumulation of ice information which is an asset to ice forecasting and necessary to the overall efficient planning and success of arctic operations.

P. V. PURKRABEK
Captain, U.S. Navy
Commander

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TABLES

ILLUSTRATIONS

PART I - EASTERN ARCTIC

1. GENERAL

Resupply of the eastern Arctic during 1971 was conducted by the Military Sealift Command (MSC). MSC ships carried bulk cargoes to Goose Bay, Sondre Stromfjord, Itivdleq, Thule, and Kulusuk. These locations and other place name references in the text are presented in figure 1. For presentation purposes, the North American Arctic is divided into three major regions each of which is subdivided into ice reconnaissance areas as shown in figure 2. The eastern region was resupplied by MSC, the western region by commercial shipping, and the central region by the Canadian Department of Transport (DOT).

2. ICE FORECASTING

The U.S. Naval Oceanographic Office (NAVOCEANO) conducted a long-range ice forecasting program in support of MSC eastern Arctic operations. This program included the long-range seasonal ice outlook* and 15- and 30-day forecasts used to amend the long-range outlook. Short-range forecasts and ship ice routings were provided by the Naval Weather Service.

a. Long-Range Ice Outlook

The long-range ice outlook for the eastern Arctic was designed to provide an estimate of ice conditions during the resupply season for planning a generalized and tentative arctic shipping schedule. The outlook was based initially on evaluation of oceanographic and climatic factors affecting ice formation, growth, and drift. Forecasts of ice disintegration and predicted trends were then based on comparison of this evaluation with historical data.

In addition, a comprehensive aerial survey of the Labrador Sea, Davis Strait, and Baffin Bay from 20 through 24 March provided information on distribution, age, and topography of the ice. Data extracted from ESSA 9 and ITOS I satellite photographs between 22 and 25 March provided information for the Labrador Sea, the east Greenland coast and the Denmark Strait. The current environment was compared to historical ice conditions to determine possible analogies. After incorporation of this information, predicted trends for the opening of the various ports were related to normal dates when ice concentrations would permit ships to safely enter these ports with and without icebreaker assistance.

The outlook also contained prognosticated mid-monthly ice charts for May through August, together with envelopes of minimum and maximum ice edges observed since 1953. The outlook was presented at a briefing of COMSCLANT and was distributed to other cognizant commands.

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*U.S. Naval Oceanographic Office, The Eastern Arctic Ice Seasonal Outlook, 1971, H. O. SP-60(71). April 1971.

FIGURE I PLACE NAME CHART

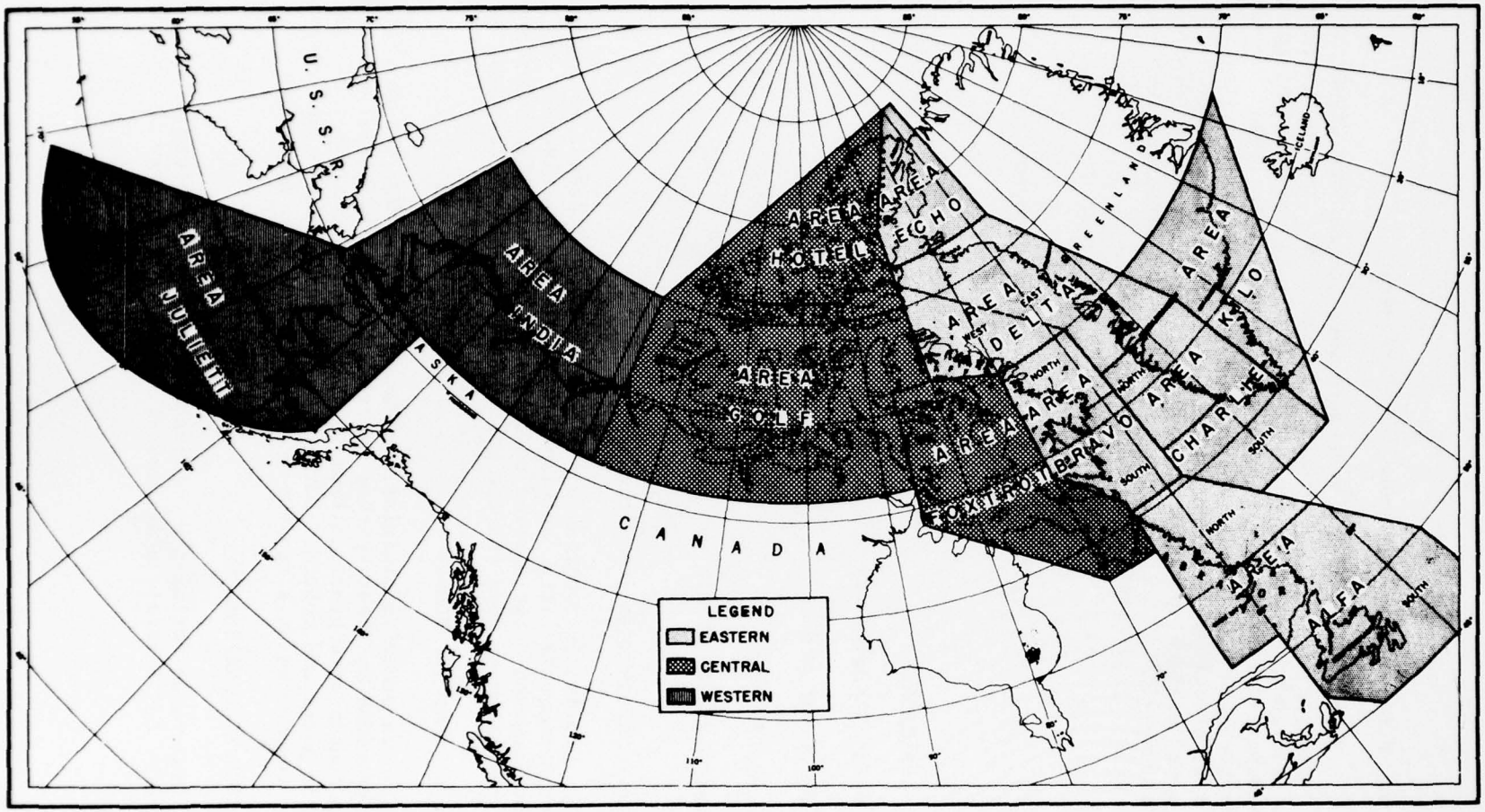


FIGURE 2 RESUPPLY AND ICE RECONNAISSANCE AREAS

b. Fifteen- and Thirty-Day Ice Forecasts

Fifteen- and 30-day forecasts were issued from NAVOCEANO via radioteletype (RATT) twice monthly between 21 May and 22 November. These forecasts were revisions of the long-range outlook and contained more detailed information on ice edge, concentration, and floe size. Forecasts were based on aerial reconnaisance, satellite data, ship reports, historical ice information, and ESSA 30-day prognostic charts of the mean sea-level pressure and 700-millibar-height departure from normal. Commencing with 20 October, the 15- and 30-day forecasts were freezeup forecasts. Forecasts are summarized in table 1.

Table 1

Fifteen- and Thirty-Day Ice Forecasts
Eastern Arctic, 1971

Site-Area	Period	Number 15-Day	Number 30-Day	Total
Goose Bay-Labrador Sea	1 May-21 June 20 Oct-22 Nov	7	7	14
Sondre Stromfjord	21 May- 7 June 20 Oct-22 Nov	5	3	8
Thule-Baffin Bay	21 May-20 Aug 20 Oct-22 Nov	10	10	20
Kulusuk-Denmark Strait	21 Jun- 6 Aug	4	3	7
		26	23	49

c. Short-Range Ice Forecasts

Forecasts covering a period of 5 days or less were issued by the Fleet Weather Facility, Suitland, Maryland. Ice advisories and forecasts commenced when ships entered operational areas and terminated when shipping was completed or when the ice was no longer a hazard to shipping.

d. Ship Ice Routes

In order to minimize ice damage to shipping, ice routing service was provided by Fleet Weather Central, Norfolk, Virginia. Optimum track ship routes were provided from the last port of call in the Atlantic to arctic ports and return. During the periods of icebreaker escort, routes were terminated at a rendezvous point in the port approaches.

3. ICE RECONNAISSANCE

Long-range aerial ice reconnaissance of the eastern Arctic was provided by P3A aircraft stationed at Bermuda. A summary of regular flights

and hours flown over each reconnaissance area each month, including transit time, is given in table 2. Flight hours for each mission were apportioned to the various reconnaissance areas. Immediate tactical support was provided by icebreaker-based helicopters which made local ice observations.

Table 2

Ice Reconnaissance Flights, Eastern Arctic, 1971

Month	Flts.	Total Hours	ALFA	BRAVO	CHARLIE	DELTA	ECHO	KILO	Hours of Ice Obs.
Feb	1	9.3	0	0	0	0	0	9.3	6.0
March	3	23.7	3.9	3.8	4.5	8.6	0.9	2.0	13.8
April	4	29.6	8.7	3.2	3.9	7.4	1.9	4.5	17.3
May	1	9.0	2.0	1.5	2.0	0	0	3.5	3.2
June	7	48.6	11.8	7.4	1.9	16.0	2.2	9.3	22.9
July	7	53.4	9.6	6.5	11.6	11.5	1.8	12.4	16.5
Aug	4	26.8	0	1.8	0	3.7	0	21.3	12.4
Sep	1	9.0	0	0	0	0	0	9.0	3.5
Oct	5	36.9	0	0	0	5.2	0.6	31.1	10.4
Nov	6	47.8	0	3.3	3.9	19.4	1.1	20.1	16.4
Dec	1	10.2	2.1	4.5	0	0	0	3.6	5.9
Totals	40	304.3	38.1	32.0	27.8	71.8	8.5	126.1	128.3

Several other sources of ice reconnaissance data over the eastern Arctic augmented the data obtained by P3A flights. These included 4 U.S. Coast Guard flights in January listed in table 3, in which Navy ice observers participated. Other supplementary ice reconnaissance data covered initial and terminal legs of Project BIRDS EYE missions and Danish ice reconnaissance conducted primarily along the south and east Greenland coasts including 83 flights totaling approximately 385 hours. Some Canadian observations in Baffin Bay and Labrador Sea were also utilized.

Table 3

Participation in U.S. Coast Guard Flights,
Eastern and Western Arctic, 1971

Month	Flts.	Total Hours	ALFA	BRAVO	CHARLIE	INDIA	JULIETT	Hours of Ice Obs.
Jan	4	25.0	18.6	1.7	4.7	0	0	10.4
Mar	1	6.5	0	0	0	0	6.5	4.0
May	3	33.0	0	0	0	0	33.0	12.1
June	1	10.1	0	0	0	6.9	3.2	3.1
Totals	9	74.6	18.6	1.7	4.7	6.9	42.7	29.6

4. SUPPORTING PROJECTS

a. Project BIRDS EYE

In conjunction with research and development of ice forecasting techniques for the Arctic Basin and to provide ice forecasting support, Project BIRDS EYE consisted of a series of seven ice reconnaissance missions (BE 1-71 through BE 7-71), with several flights in each mission, over the North American Arctic. BIRDS EYE missions totaling 42 flights for approximately 460 hours were conducted on standard tracks primarily over the Arctic Basin. Data from BIRDS EYE missions 1 through 5 were included, where applicable, in the charts presented in appendixes A and C. BIRDS EYE 6-71 and 7-71 data are presented in appendix E.

b. Classified Operations

The following forecasts were issued to a military command for two continuing classified projects in specific geographical areas:

March - seven short-range wind and ice forecasts
September - one 15-day ice forecast
October - two 15- and 30-day ice forecasts
November - two 15- and 30-day ice forecasts
December - one 15-day ice forecast

5. OBSERVED ICE CONDITIONS

Ice conditions observed by aerial reconnaissance in the eastern North American Arctic are presented in appendix A. Ice data were obtained primarily from U.S. aerial ice reconnaissance, including BIRDS EYE flights, supplemented by U.S. Coast Guard flights and Danish aerial reconnaissance. Ice conditions observed by satellite in the eastern North American Arctic are presented in appendix B.

Fast ice in Itivdleq broke up within its normal range as forecasted by the outlook. However, the escorted and unescorted trends for Sondrestrom were 9 and 6 days later than forecast, respectively, owing to temperatures that were lower than those forecasted for May and the first week of June. Ice concentration in the approaches to Goose Bay decreased to less than six-eighths by 15 June, 1 day later than forecasted in the outlook. Unescorted entry to Goose Bay occurred as predicted on 8 July, 15 days later than normal, because of the predominance of onshore drift along the Labrador coast during April through June. Ice concentration in the Thule approaches decreased to less than six-eighths by 16 July, resulting in normal escorted entry into Thule as predicted in the outlook. Open to very close pack ice persisted in central and northern Baffin Bay until the end of July. Thus, the later than normal unescorted entry date of 1 August forecasted in the outlook was verified.

Escorted entry into Kulusuk was normal as predicted by the outlook; but the wider than normal ice pack north of Kulusuk, combined with large quantities of multi-year ice north of 66°N, still posed great potential for later drift into the Kulusuk approaches. However, this potential drift never materialized even though the pack ice north of 66°N remained unusually extensive into August owing to anomalous light and variable and offshore winds during July along the east Greenland coast. Consequently, unescorted entry into Kulusuk was possible by 3 August, 20 days earlier than forecast by the outlook. Verification of the long-range outlook is given in table 4.

Table 4

Long-Range Ice Outlook Verification, 1971

Escorted Entry*

Port	Normal	Predicted Trend	Observed
Itivdleq	17 April	Normal (±4 days)	14 April
Sondre Stromfjord	29 May	Earlier (2 to 5 days)	5 June
Goose Bay	5 June	Later (5 to 9 days)	15 June
Thule	12 July	Normal (±4 days)	16 July
Kulusuk	14 July	Normal (±4 days)	15 July

Unescorted Entry**

Port	Normal	Predicted Trend	Observed
Itivdleq	1 May	Normal (±4 days)	30 April
Sondre Stromfjord	7 June	Earlier (2 to 5 days)	11 June
Goose Bay	23 June	Later (10 to 15 days)	8 July
Thule	23 July	Later (5 to 9 days)	1 August
Kulusuk	18 August	Later (5 to 9 days)	3 August

*Concentration in approaches 6/8 or less and fast ice, if any, in port well weakened.
**Concentrations in approaches and port 1/8 or less.

PART II - WESTERN ARCTIC

1. GENERAL

During the 1971 resupply season in the western Arctic, short-range ice forecasting support was provided by the Fleet Weather Facility at Suitland, Maryland. NAVOCEANO was responsible for providing long-range forecasts in support of military and oceanographic operations.

2. ICE FORECASTING

A total of forty-eight 15- and 30-day ice forecasts for the north Alaskan coast and the Bering and Chukchi Seas were issued throughout the year. Forecasts were issued twice monthly and included information in ice pack edges, concentrations, stages of development, and ice thickness for 6 specified points. Twenty-six forecasts were sent to COMALSEAFRON, 12 to COMHAWSEAFRON, and 10 to Fleet Weather Facility, Kodiak, Alaska.

3. ICE RECONNAISSANCE

Aerial reconnaissance was conducted over areas INDIA and JULIETT by P3A aircraft stationed at Adak, Alaska; by Project BIRDS EYE aircraft from Eielson AFB, Fairbanks, Alaska; and by utilizing flights by the Arctic Research Laboratory (ARL) from Point Barrow. Additional ice data were obtained by 5 U.S. Coast Guard flights listed in table 3, in which Navy ice observers participated. A summary of P3A flights and hours flown, including ARL missions, for each month over each area and annual totals is presented in table 5. Flight hours for each mission were apportioned to reconnaissance areas INDIA and JULIETT.

4. OBSERVED ICE CONDITIONS

Ice conditions observed by aerial reconnaissance in the western North American Arctic are presented in appendix C. The data were obtained primarily by scheduled aerial reconnaissance and were supplemented by BIRDS EYE flights 1-71 through 5-71. Ice conditions observed by satellite in the western North American Arctic are presented in appendix D.

Table 5

Ice Reconnaissance Flights, Western Arctic, 1971

Month	No. of Flts	Total Hours	INDIA	JULIETT	Hours of Ice Obs.
Feb	1	11.0	6.0	5.0	5.5
Mar	2	15.8	8.7	7.1	6.2
April	2	19.5	0	19.5	13.4
June	1	8.5	0	8.5	4.0
July	6	39.3	39.3	0	13.4
Aug	7	40.7	40.7	0	14.6
Sept	2	11.9	11.9	0	3.4
Oct	2	14.5	13.5	1.0	4.1
Nov	1	9.1	5.3	3.8	5.2
Dec	3	24.8	4.9	19.9	12.3
Totals	27	195.1	130.3	64.8	82.1

PART III - SATELLITE OBSERVATIONS

1. GENERAL

Ice information, including ice edges, concentrations, and large leads or water openings, was interpreted from satellite photographs between 3 March and 22 September. The data for the eastern and western Arctic and Canadian Archipelago are presented in appendixes B and D, respectively.

Ice data derived from ESSA 9, ITOS I, and NOAA I satellite photographs may disagree with aerial reconnaissance data in some cases; however, discrepancies do not always indicate incorrect satellite ice information. Ice edges may be plotted incorrectly owing to navigational problems aboard the aircraft. The width of the ice pack sometimes appears less extensive in a satellite photograph than the width shown on an aerial reconnaissance chart for the same area during an equivalent time period. This specific discrepancy is due to the interpreter's inability to observe ice of less than 3 oktas concentration along an ice edge in the 1971 series of satellite photographs. Many leads and large openings observed within the pack ice are labeled "ice free to 3 oktas," unless the analyst was well assured that the area contained no ice, in which case the area was labeled "ice free". The notation "ice free to 3 oktas" generally infers that the center of the area is ice free and that concentrations of 1 to 3 oktas of ice are present along the periphery of the area.

Concentrations within the pack were interpreted by the analyst without reference to aerial reconnaissance data. Concentrations cannot be interpreted to the nearest okta with current resolution, except for fast ice or where the analyst is confident that compact pack ice (8 oktas) exists; therefore, concentrations are analyzed in ranges of oktas as shown in appendixes B and D. Analysis of ice conditions covered by extensive cloud cover or under conditions of poor illumination was not possible; therefore, areas of arctic darkness or extensive cloud cover are labeled with the appropriate symbols. Ice edges can be observed occasionally through thin cloud cover; however, the concentrations within the pack ice are difficult to ascertain. When such cases arise, a cloud symbol outlines the pack ice and terminates at the ice edge.

Continuous satellite coverage of the Arctic, along with consistent interpretation of the satellite data, permits observation of significant changes. Movement of ice edges, opening and closing of flaw or shore leads, changes of concentration, and gradual expansion of large water openings, such as the North Water Area, can be observed.

2. DISSEMINATED SATELLITE DATA

From 23 May until 22 September NAVOCEANO prepared a total of 72 weekly satellite ice charts for the eastern Arctic, the Canadian Archipelago, and the western Arctic showing ice edges, concentrations and water openings. A total of 468 charts was mailed to various government and private agencies during this period. Data were also extracted from these charts and transmitted via radioteletype (RATT) message to icebreakers and cognizant commands.

APPENDIX A

EASTERN ARCTIC AERIAL

RECONNAISSANCE ICE CHARTS

KEY TO ICE SYMBOLS USED IN PLOTTING ICE FEATURES

TOTAL CONCENTRATION

- Ice free
- <1 okta* (open water)
- 1-<3 oktas (very open pack)
- 3-<6 oktas (open pack)
- 6-<7 oktas (close pack)
- 7-<8 oktas (very close pack)
- 8 oktas (compact pack)

CONC = Concentration
CRK = Crack
CRKS = Cracks
FRCT = Fracture
FRCTV = Very Small Fracture
FRCTS = Small Fracture
FRCTM = Medium Fracture
FRCTL = Large Fracture
LVL = Level Ice
NDTR = Not Determined
NOPG = No Openings in Ice
OPWR = Open Water
SCTD = Scattered
SD = Snow Depth
T = Ice Thickness

COVERAGE BY SIZE

$$\frac{C}{n_1 n_2 n_3}$$

C = total concentration

n_1
- SS/NL = New Ice or Nilas
- PK = Pancake <3 m
- CK = Brash, Small Cake, Cake <20 m

n_2
- SF = Small Floe 20—100 m
- MF = Medium Floe 100—500 m

n_3
- BF = Big Floe 500—2000 m
- VF = Vast Floe 2—10 km
- GF = Giant Floe >10 km
- Fast = Fast Ice

Example: $\frac{7}{124}$ PK
- 7 = total concentration
- 1 = okta all pancake ice
- 2 = oktas small and medium ice floes
- 4 = oktas big, vast, and giant ice floes

STAGE OF DEVELOPMENT

$$\frac{A}{\text{oktas predominant, oktas secondary}}$$

AGE	AVERAGE THICKNESS
SS = Frazil, Grease, Slush, Shuga	
NL = Ice Rind, Dark Nilas, Light Nilas	<5—10 cm
G = Gray	10—15 cm
GW = Gray-White	15—30 cm
FL = Thin First-Year	30—70 cm
FM = Medium First-Year	70—120 cm
FT = Thick First-Year	>120 cm
SY = Second-Year	
MY = Multi-Year	

Example: $\frac{A}{5FM3G}$
- A = Stage of development
- 5FM = 5 oktas Medium First-Year
- 3G = 3 oktas Gray

*One okta equals one-eighth ice concentration

TOPOGRAPHY

- Rafted or Finger-Rafted Ice
- Hummocks
- (N) New Ridges
- (W) Weathered Ridges
- (V) Very Weathered Ridges
- (A) Aged Ridges
- (C) Consolidated Ridges

Example: $\frac{\text{(N) (h)}}{\text{(n)}}$

(h) height of ridges in meters
(n) tenths coverage on ice

STAGE OF MELTING

FPD = Few Puddles
MPD = Many Puddles
FTH = Few Thaw Holes
MTH = Many Thaw Holes
DRI = Dried Ice
ROT = Rotten Ice
FLO = Flooded Ice

UNDERCAST

Limit

THICKNESS OF ICE & SNOW

t_E = ice thickness in cm
s = snow depth in cm

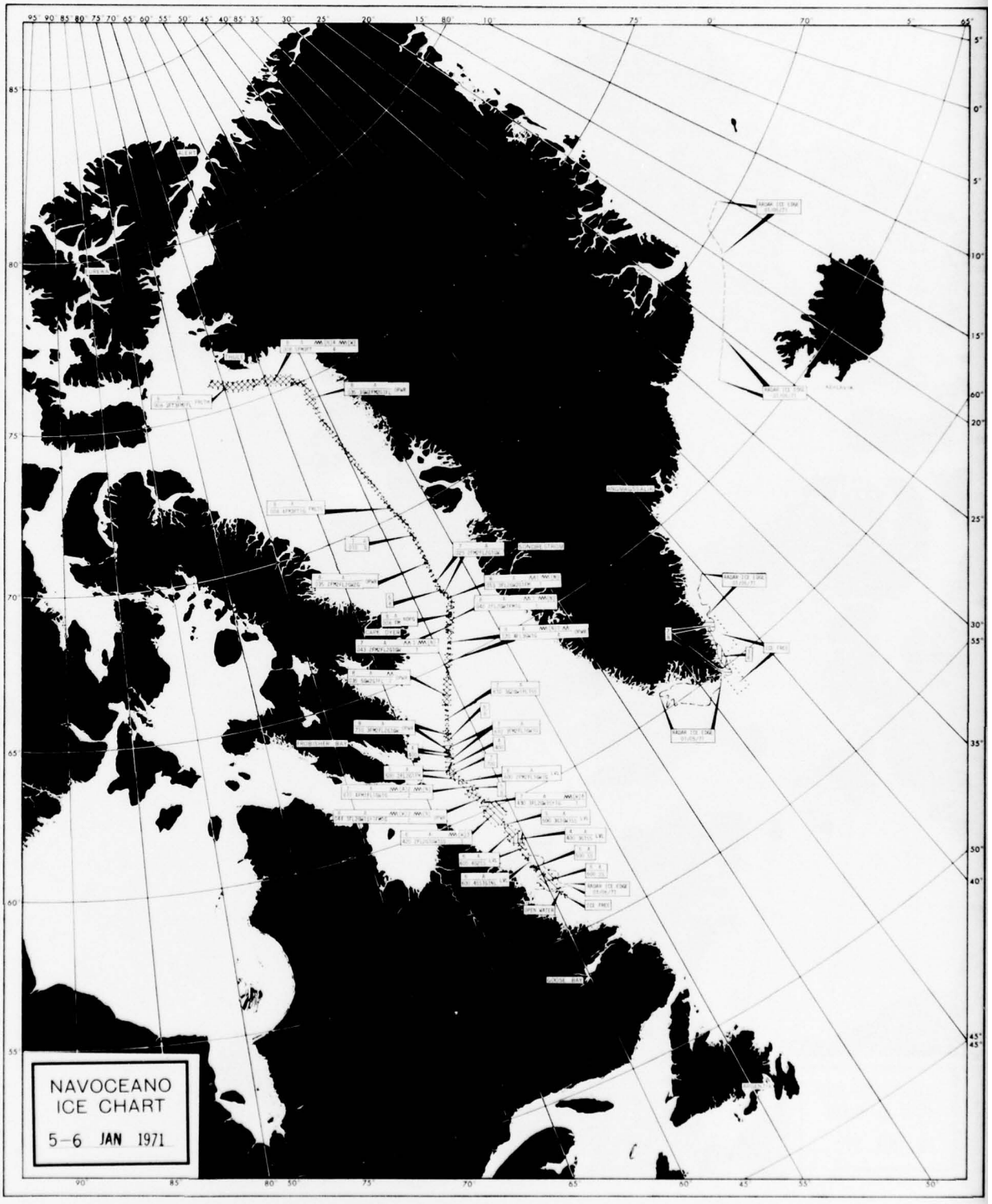
PHENOMENA

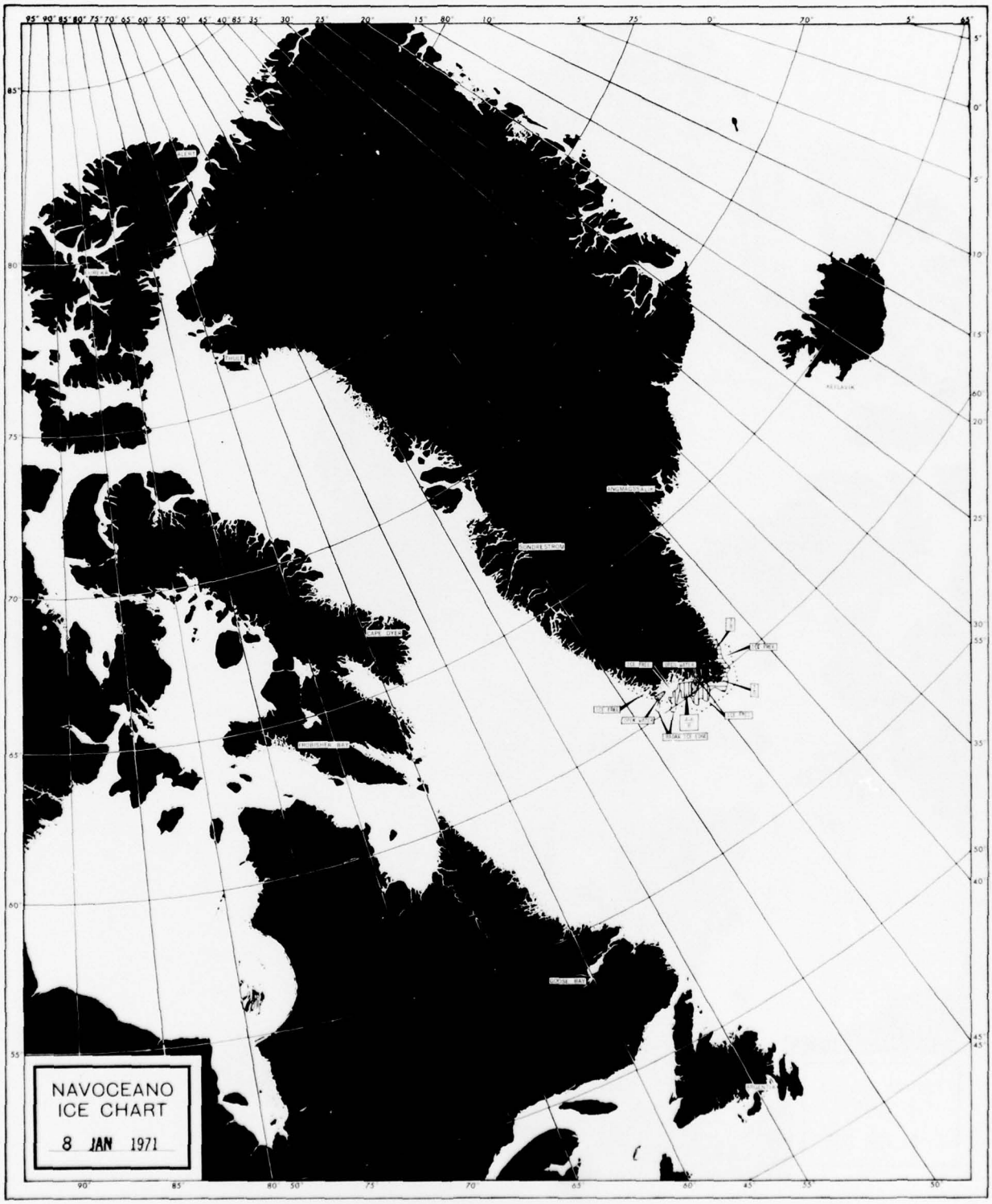
- crack
- fracture
- polynya
- lead
- (n) icebergs
- (n) bergy bits & growlers

(n) = number in area

ICE EDGE

- observed
- radar
- limit of observed data
- satellite data


NAVOCEANO
ICE CHART
5-6 JAN 1971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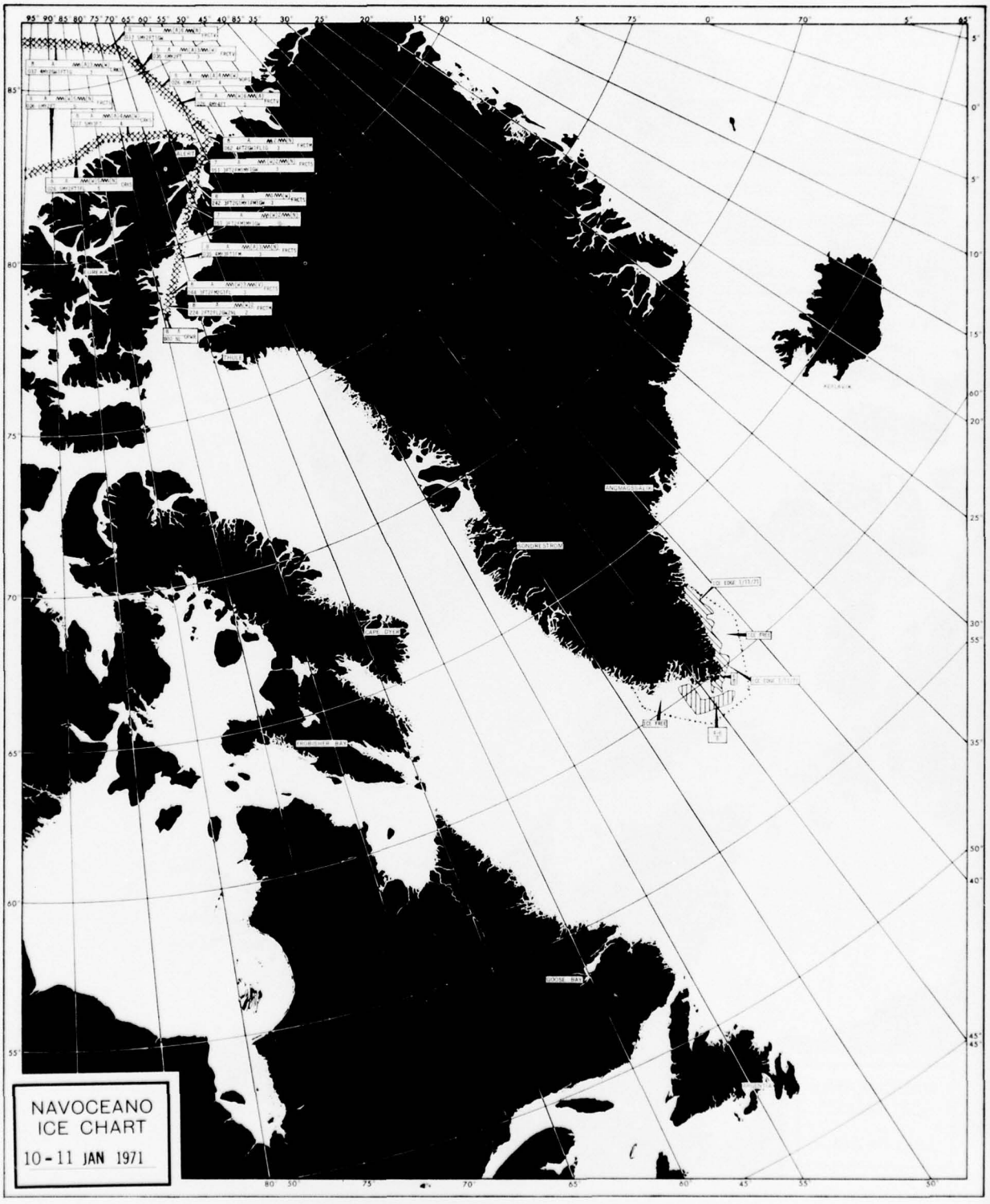
ICE CHART
8 JAN 1971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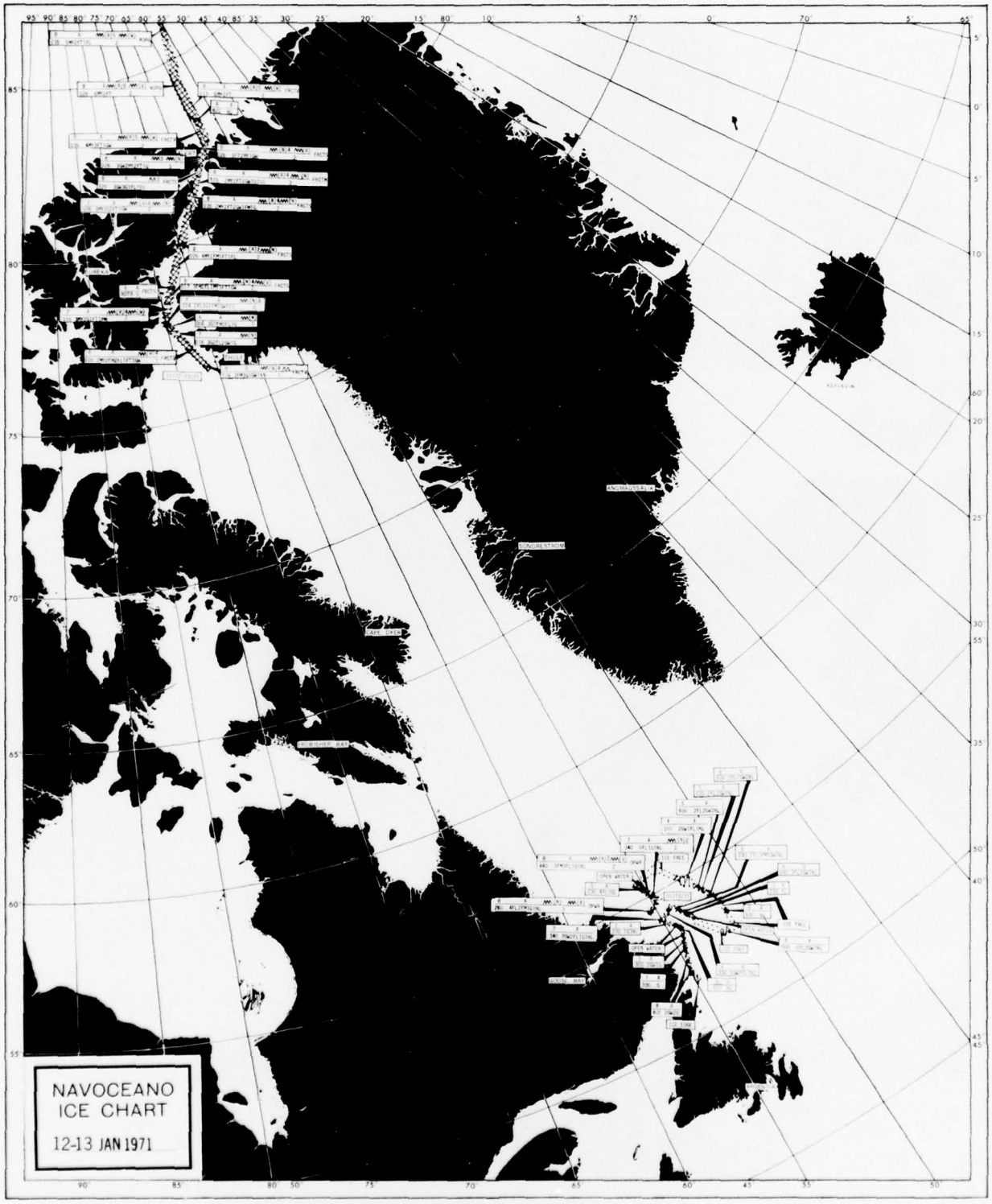
10 - 11 JAN 1971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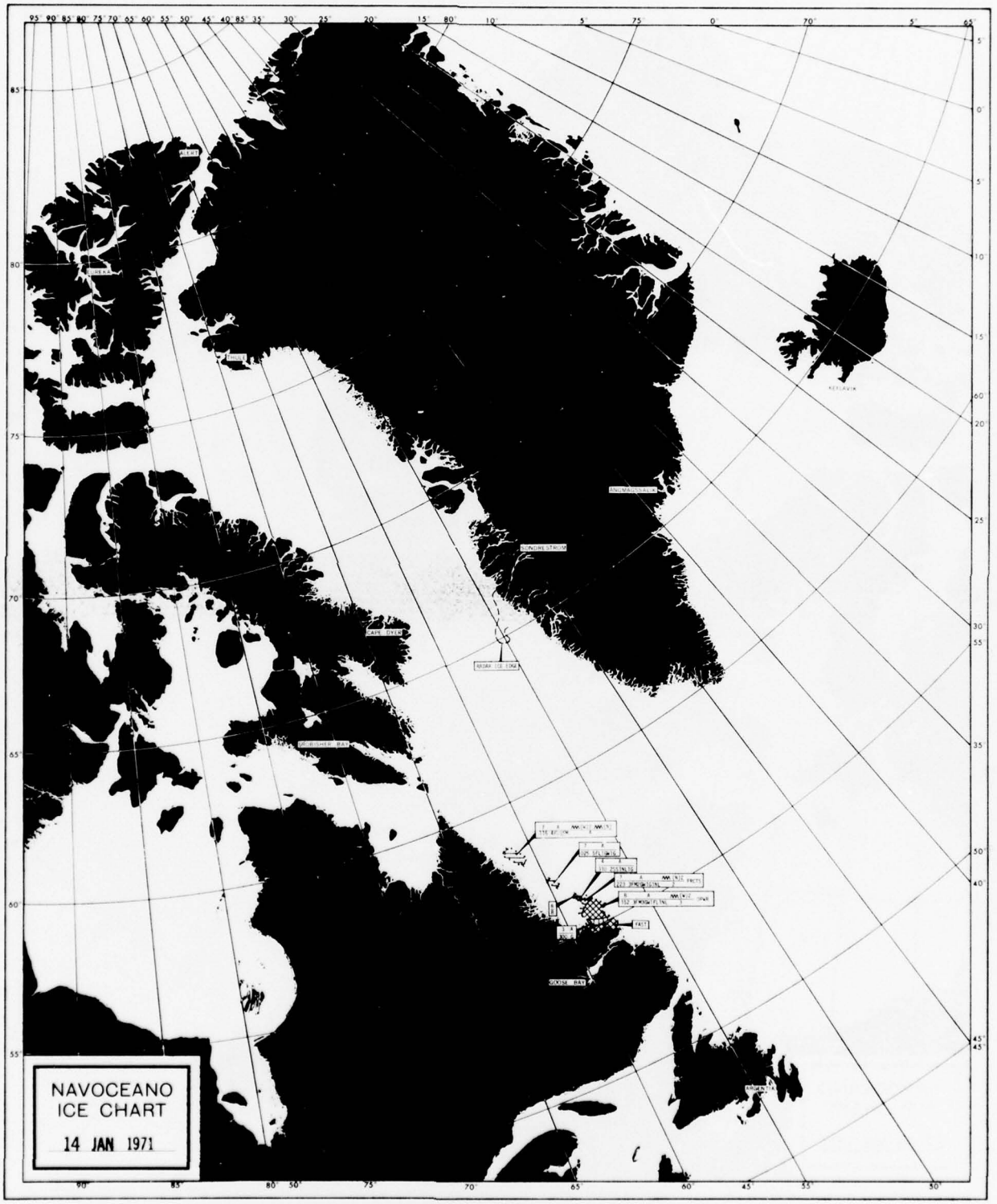
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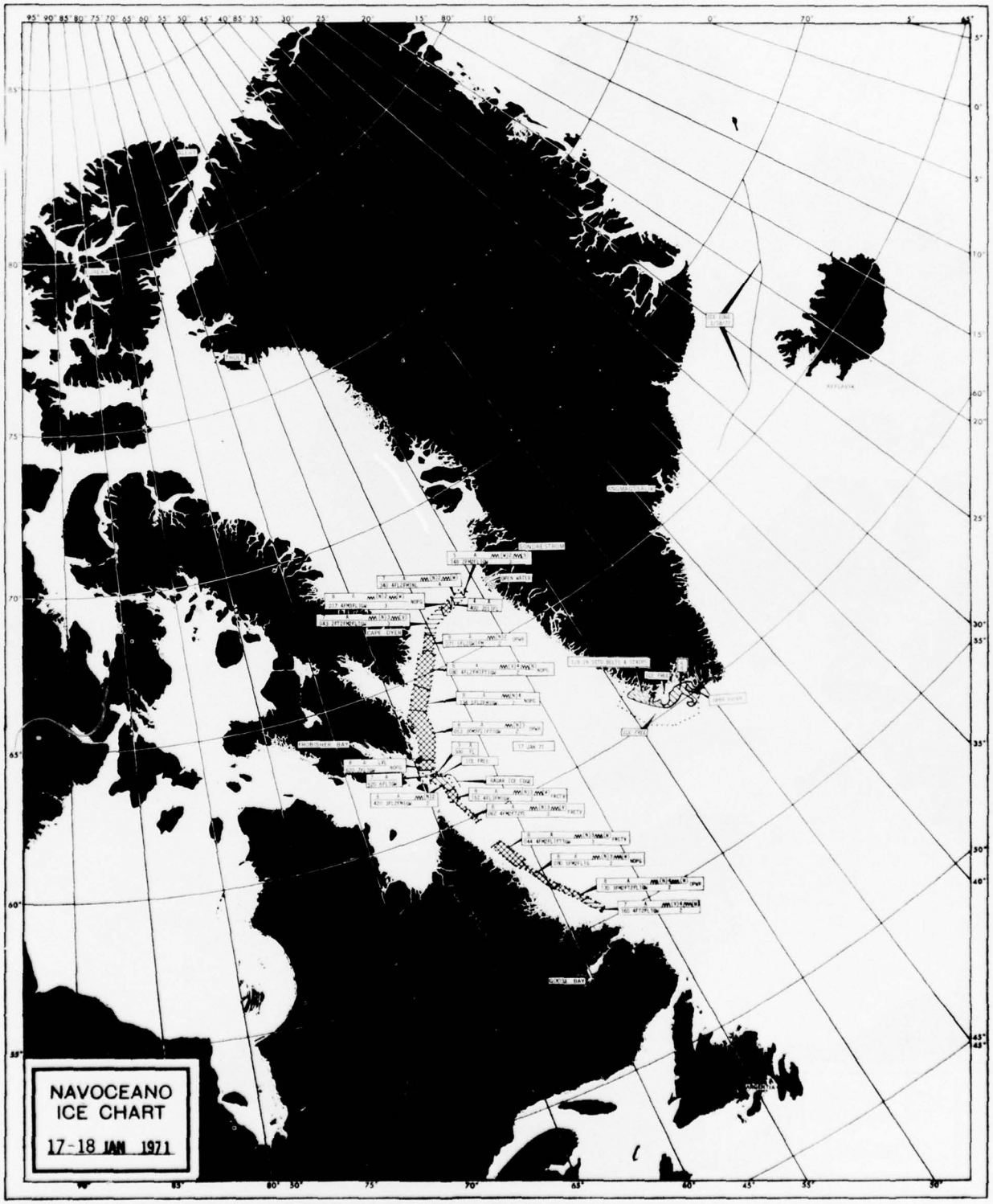
14 JAN 1971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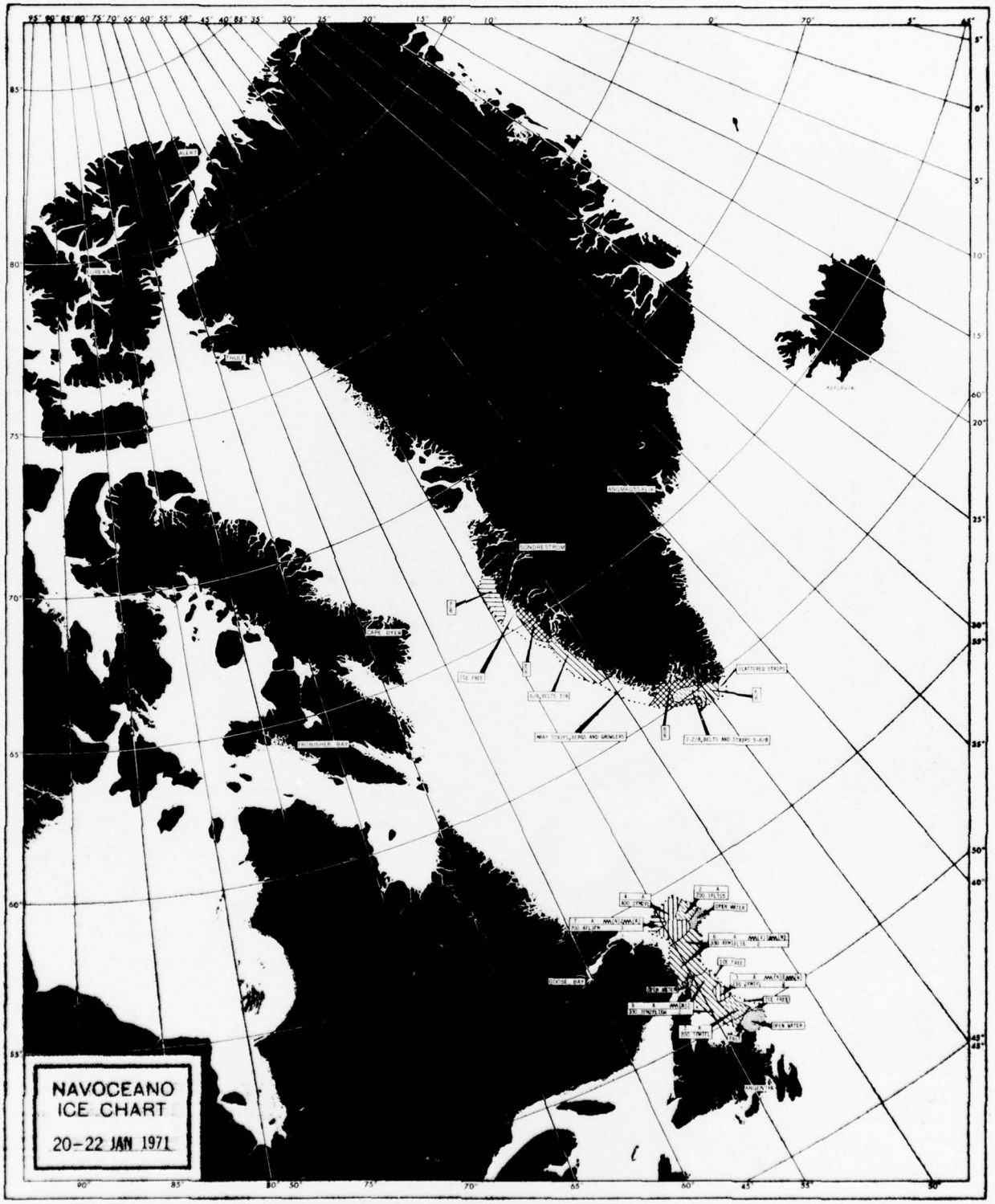
17-18 JAN 1971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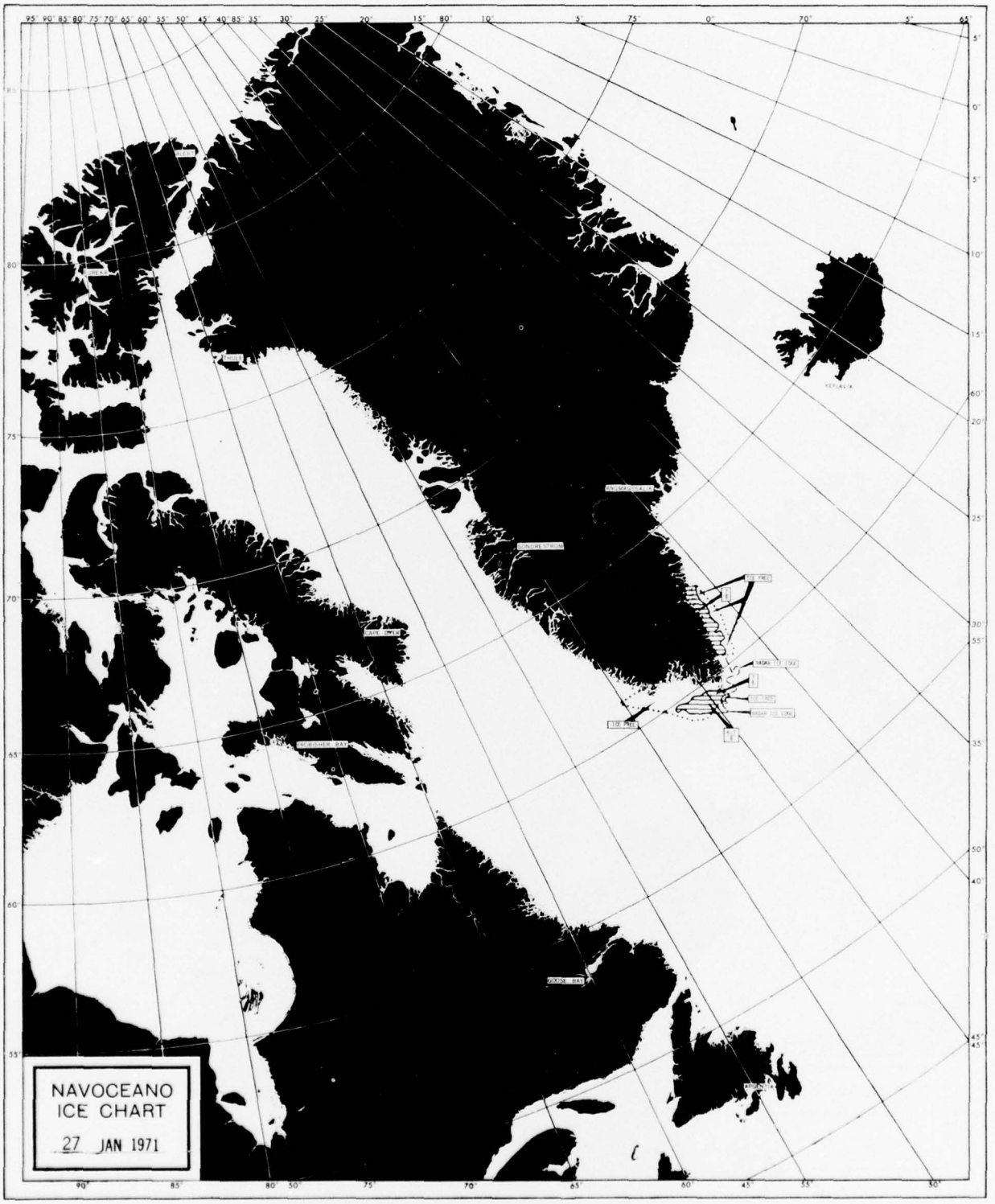
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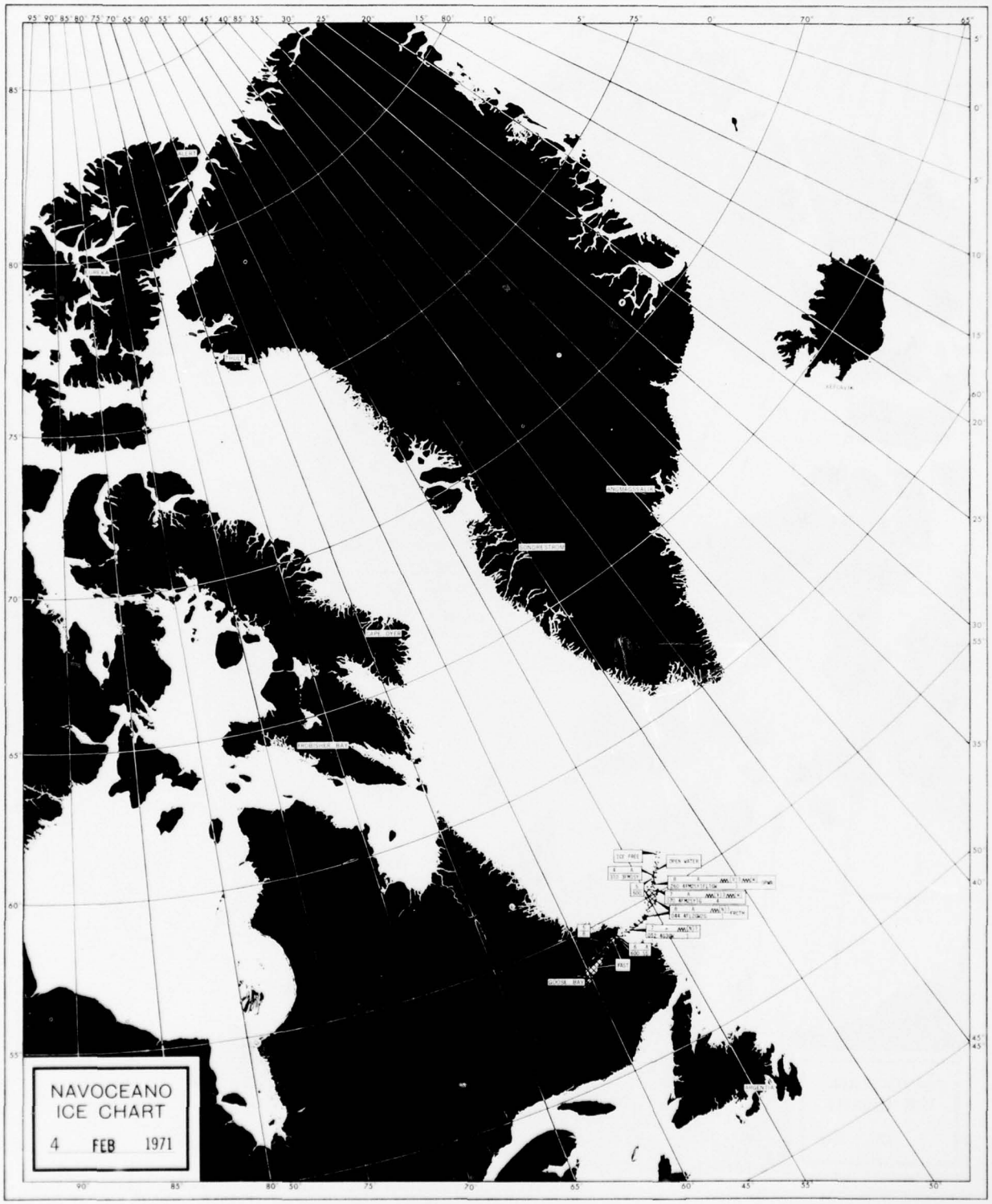
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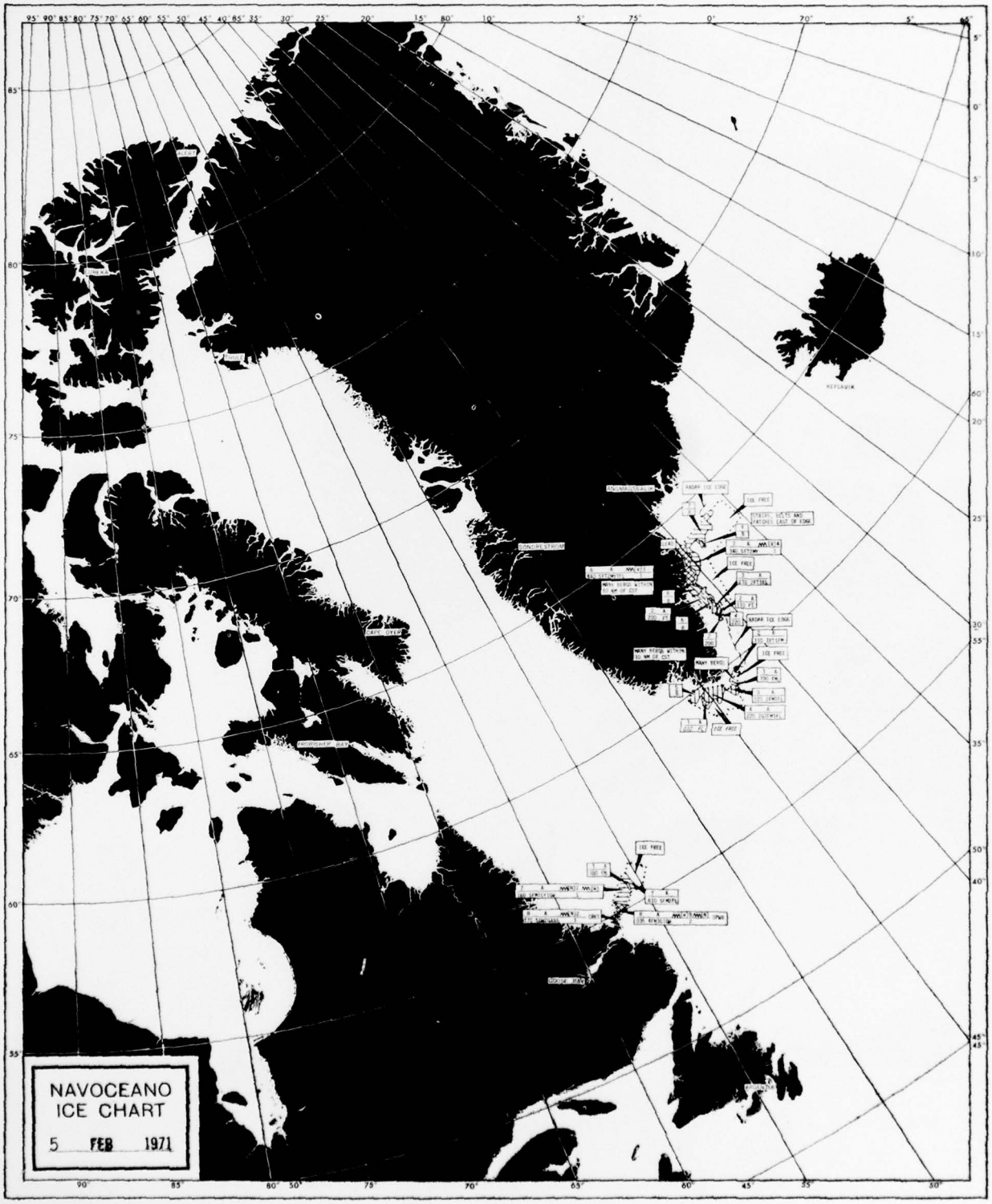
4 FEB 1971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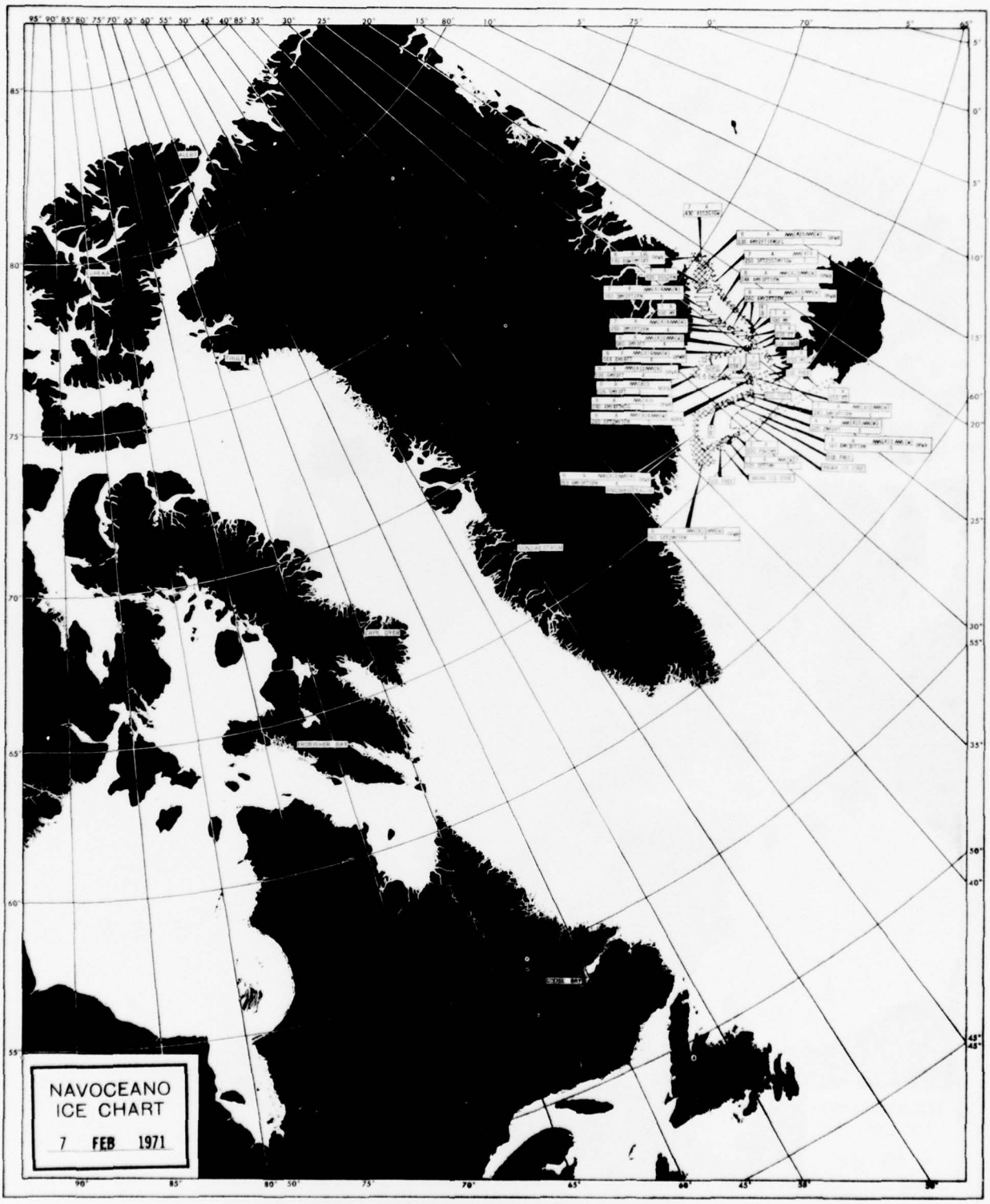
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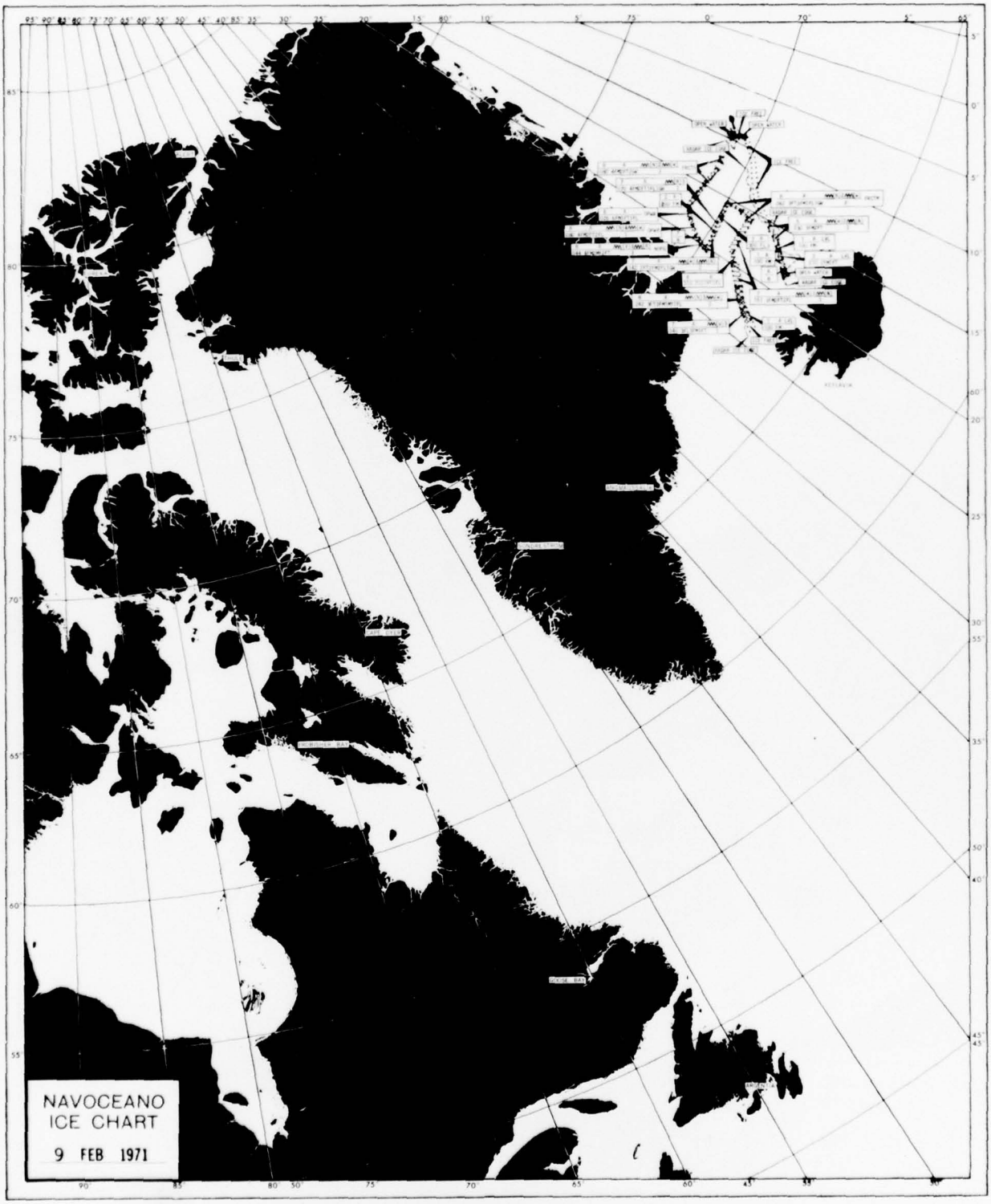
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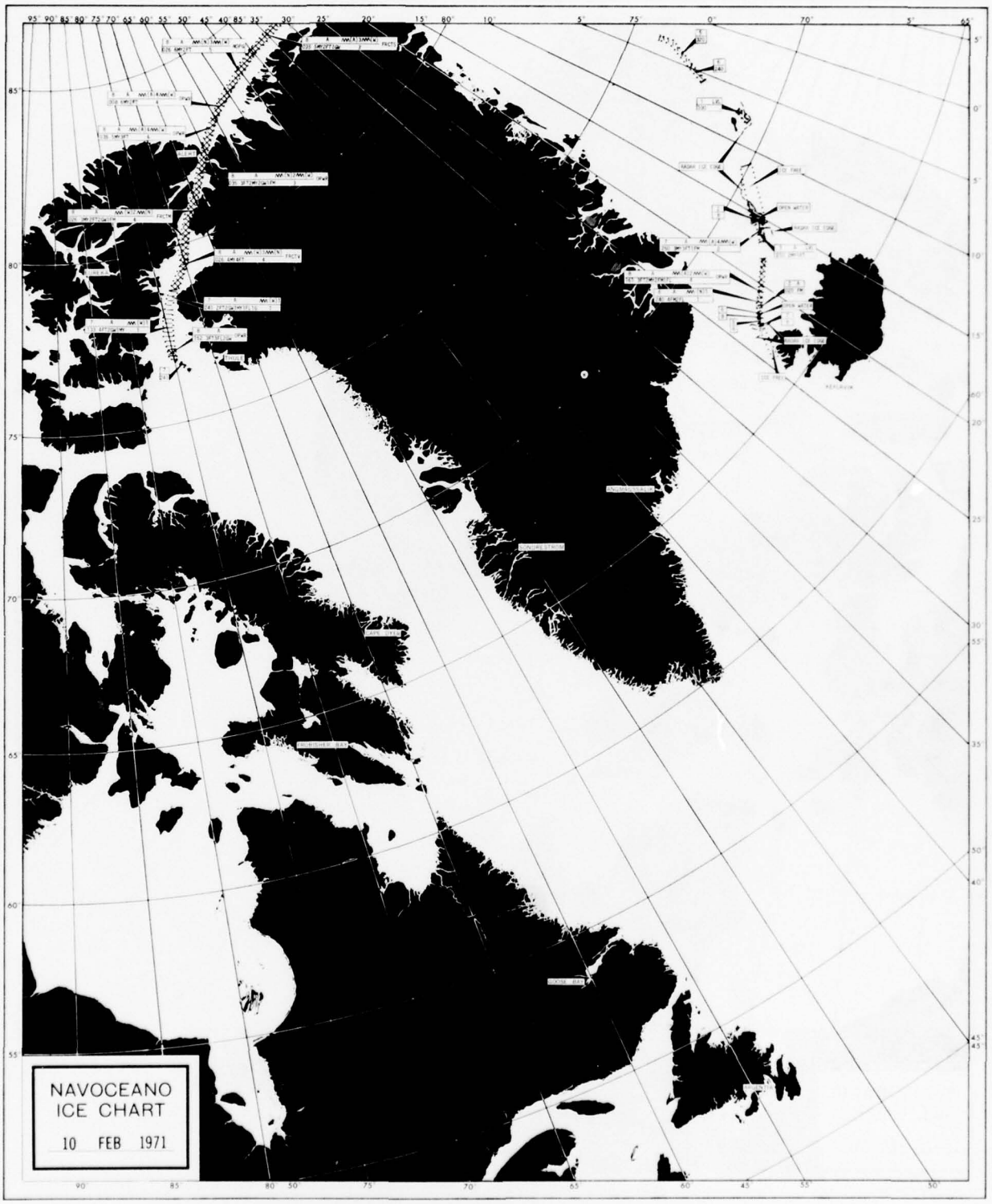
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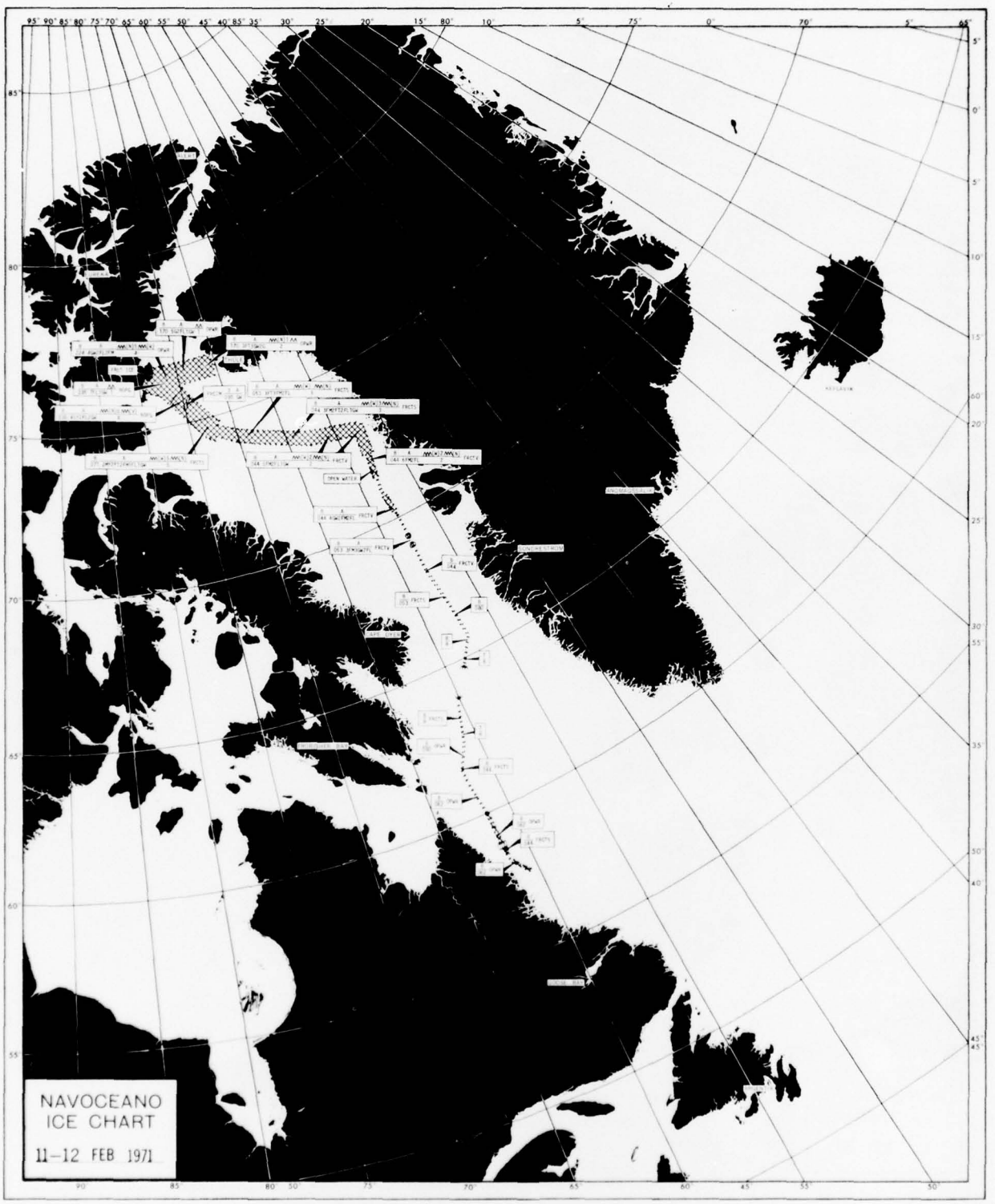
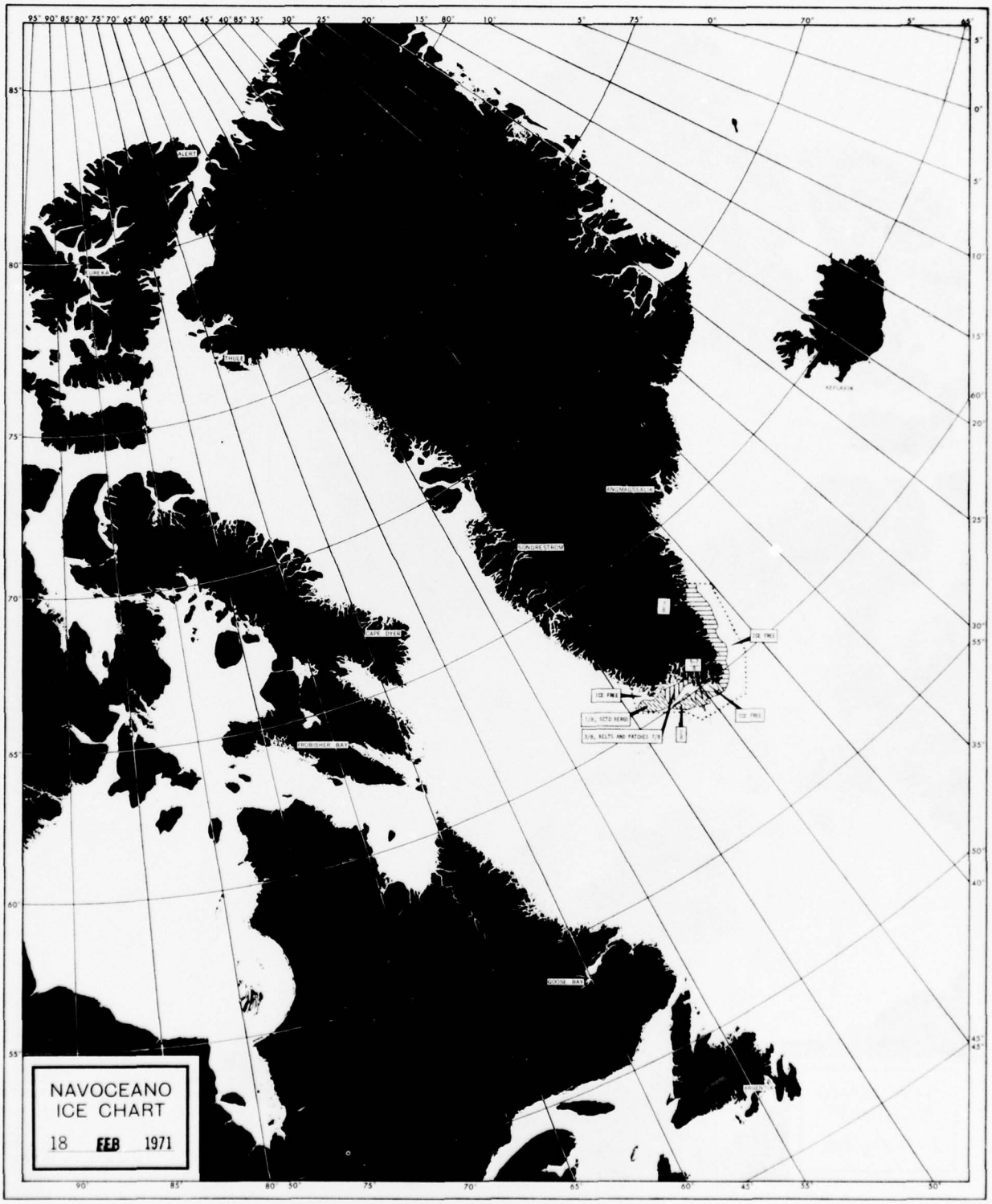
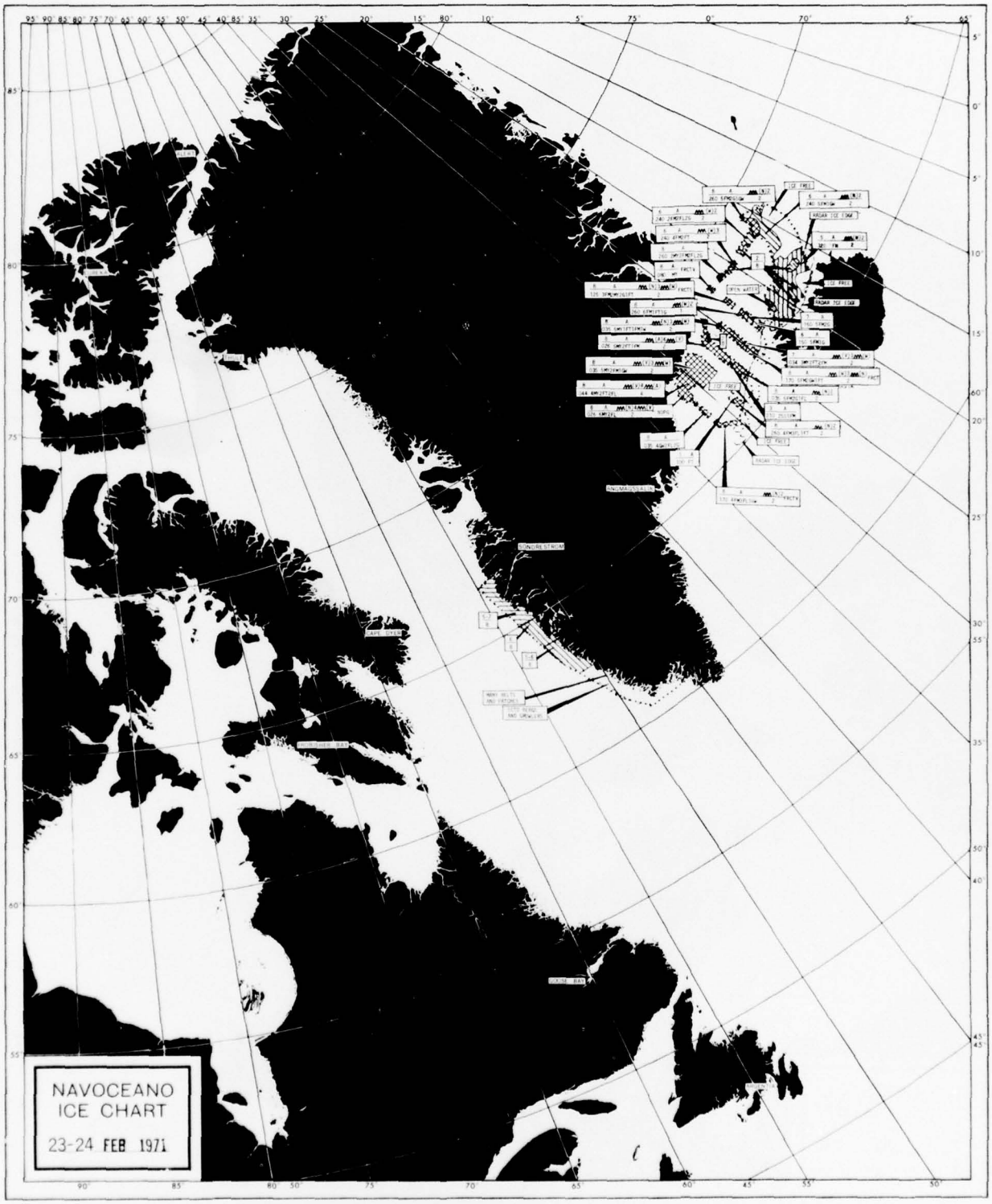

NAVOCEANO
ICE CHART
11–12 FEB 1971


NAVOCEANO
ICE CHART
18 FEB 1971
ALERT
EUREKA
THULE
ANGMAGSSALIK
IGDLORSTOVAK
CAPE DYER
FROBISHER BAY
ICE FREE
ICE FREE
ICE FREE
1/8, SCTD BERGS
3/8, BELTS AND PATCHES 7/8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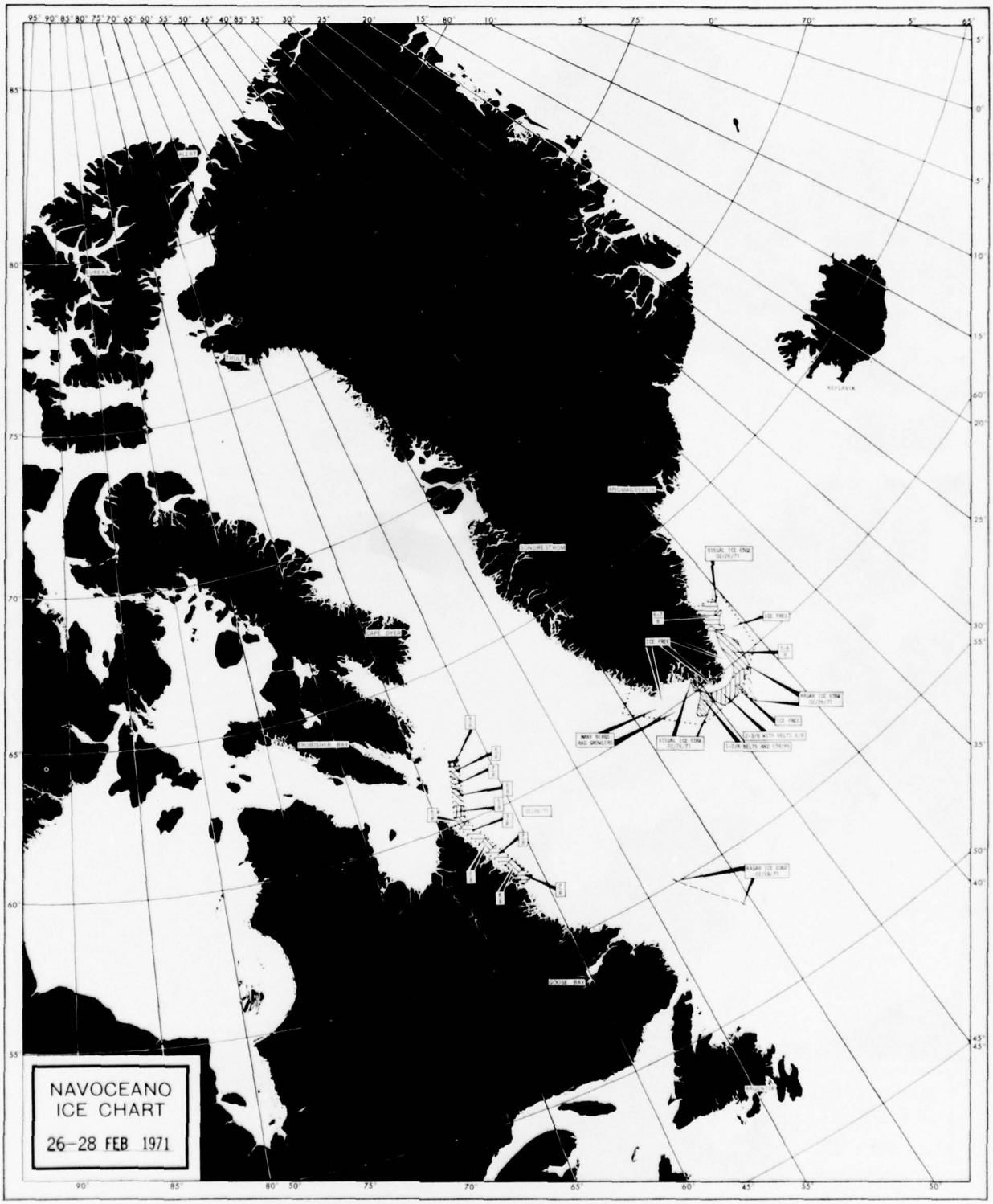
23-24 FEB 1971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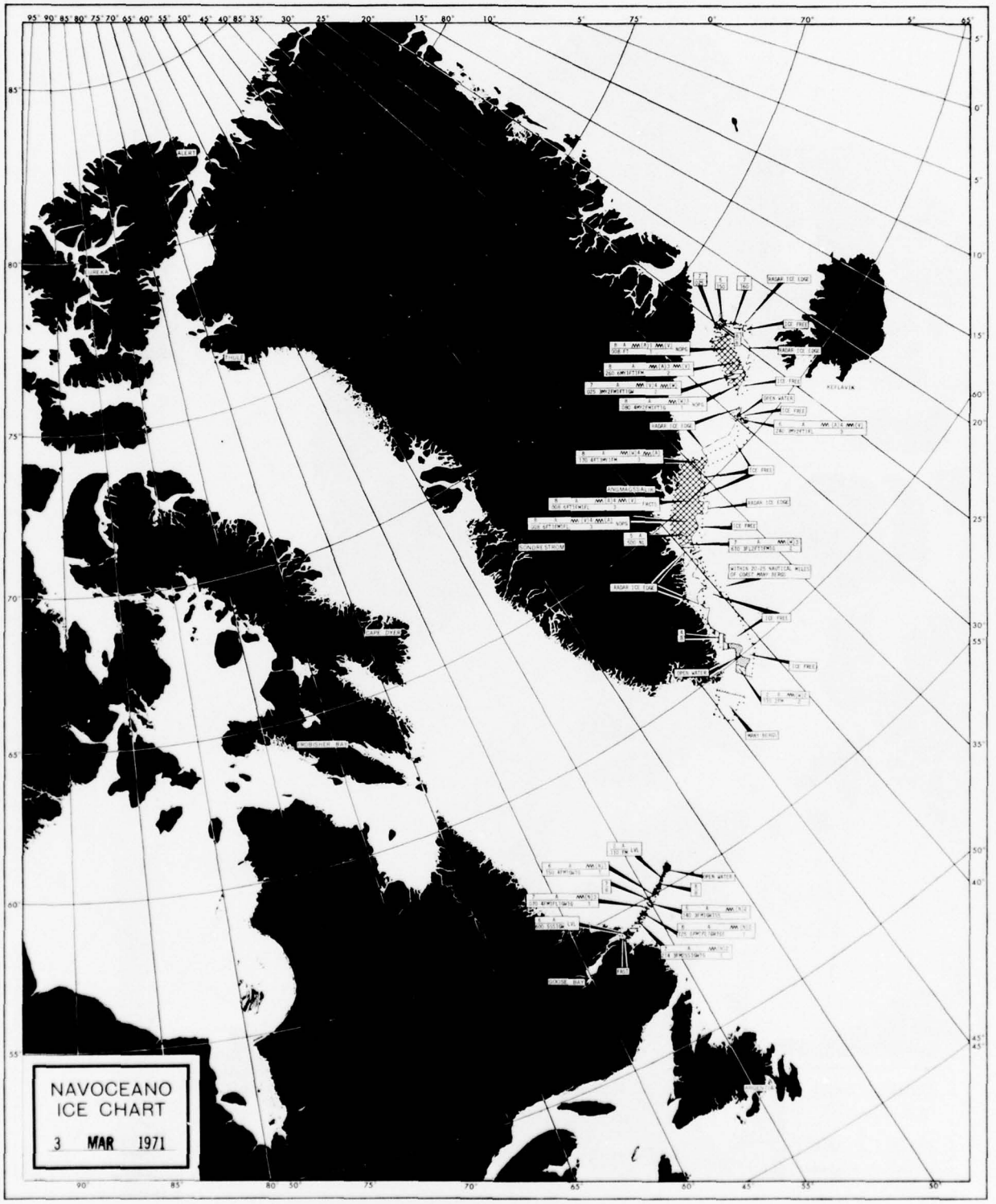
26–28 FEB 1971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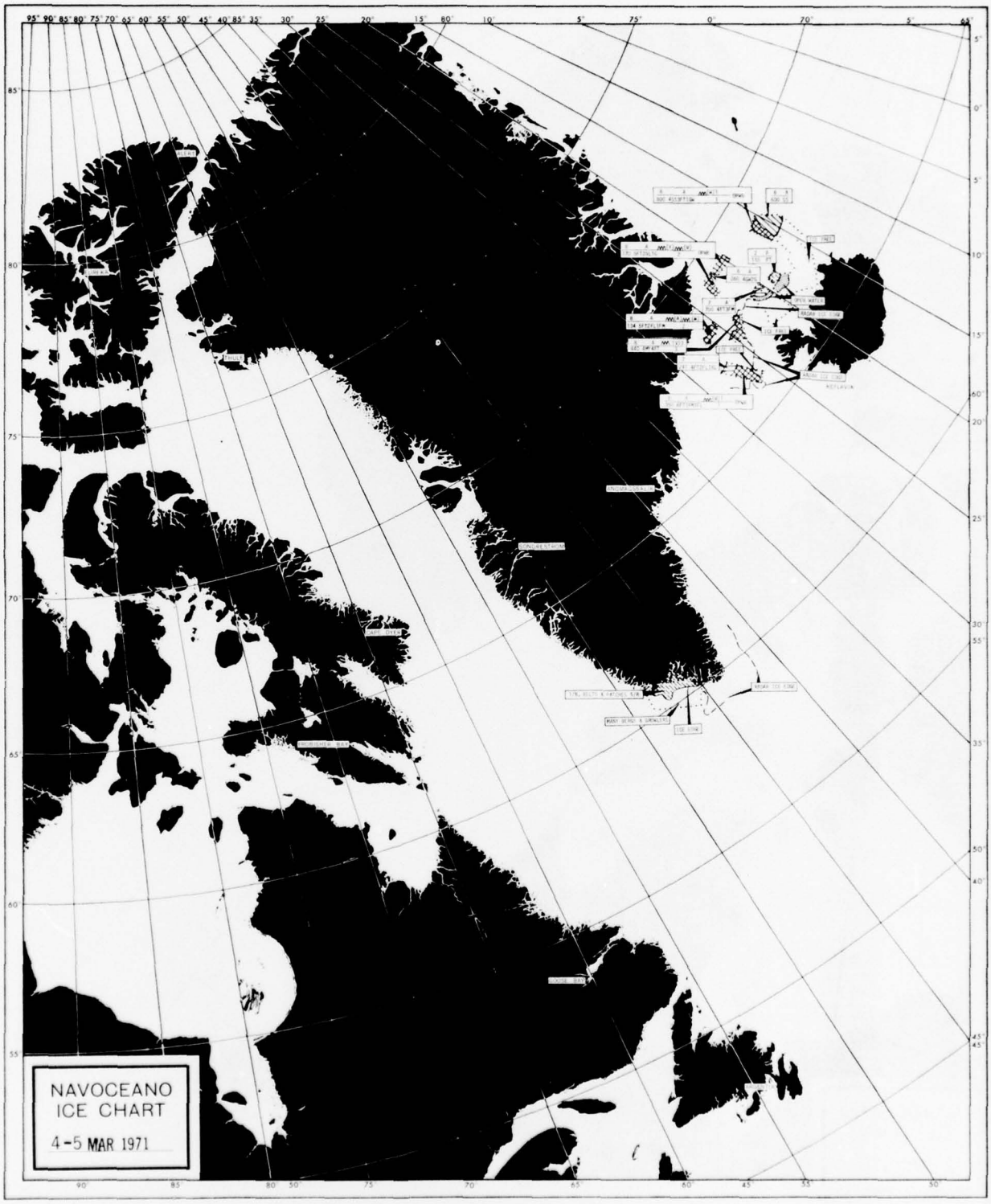
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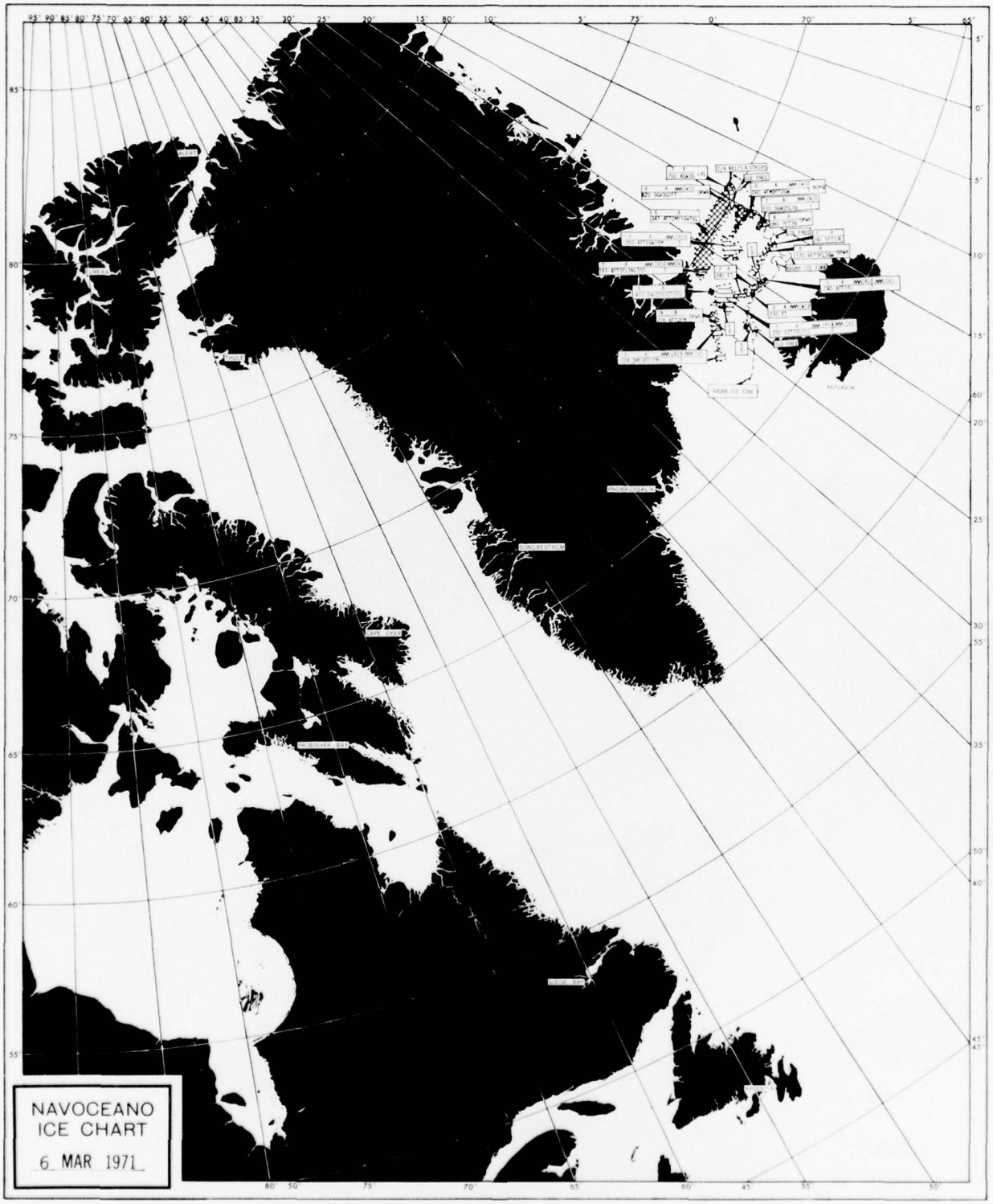
4-5 MAR 1971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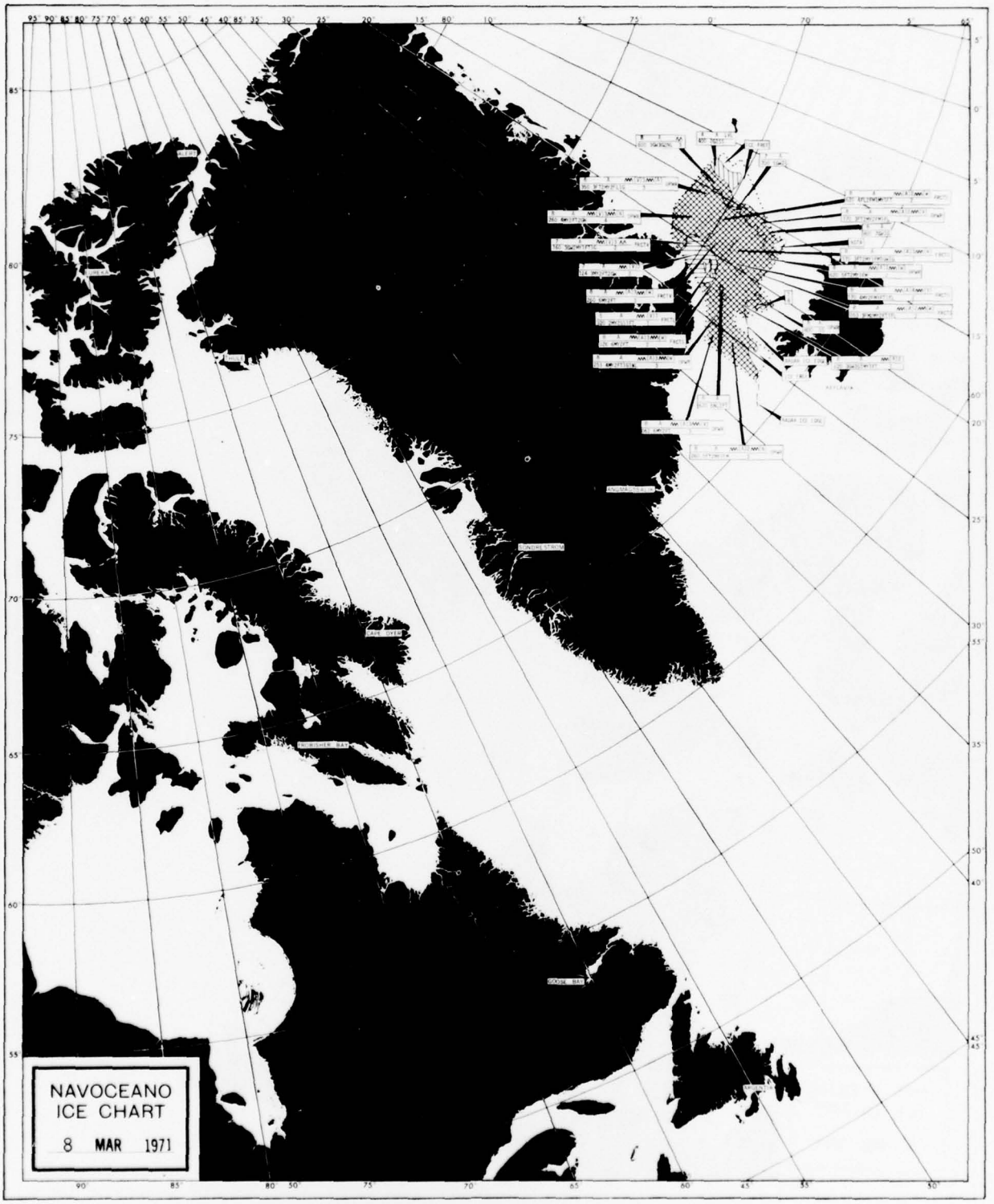
6 MAR 1971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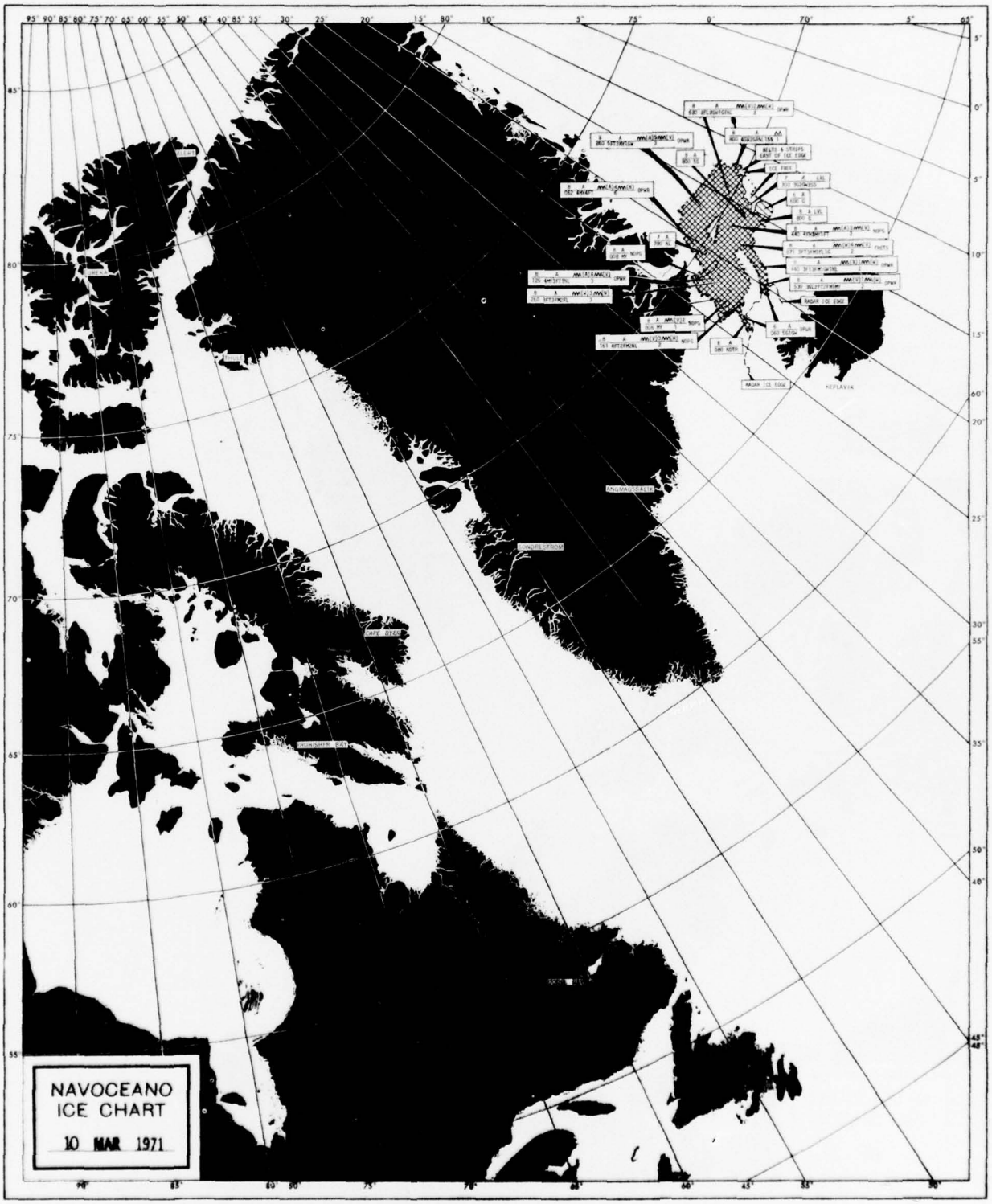
8 MAR 1971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10 MAR 1971
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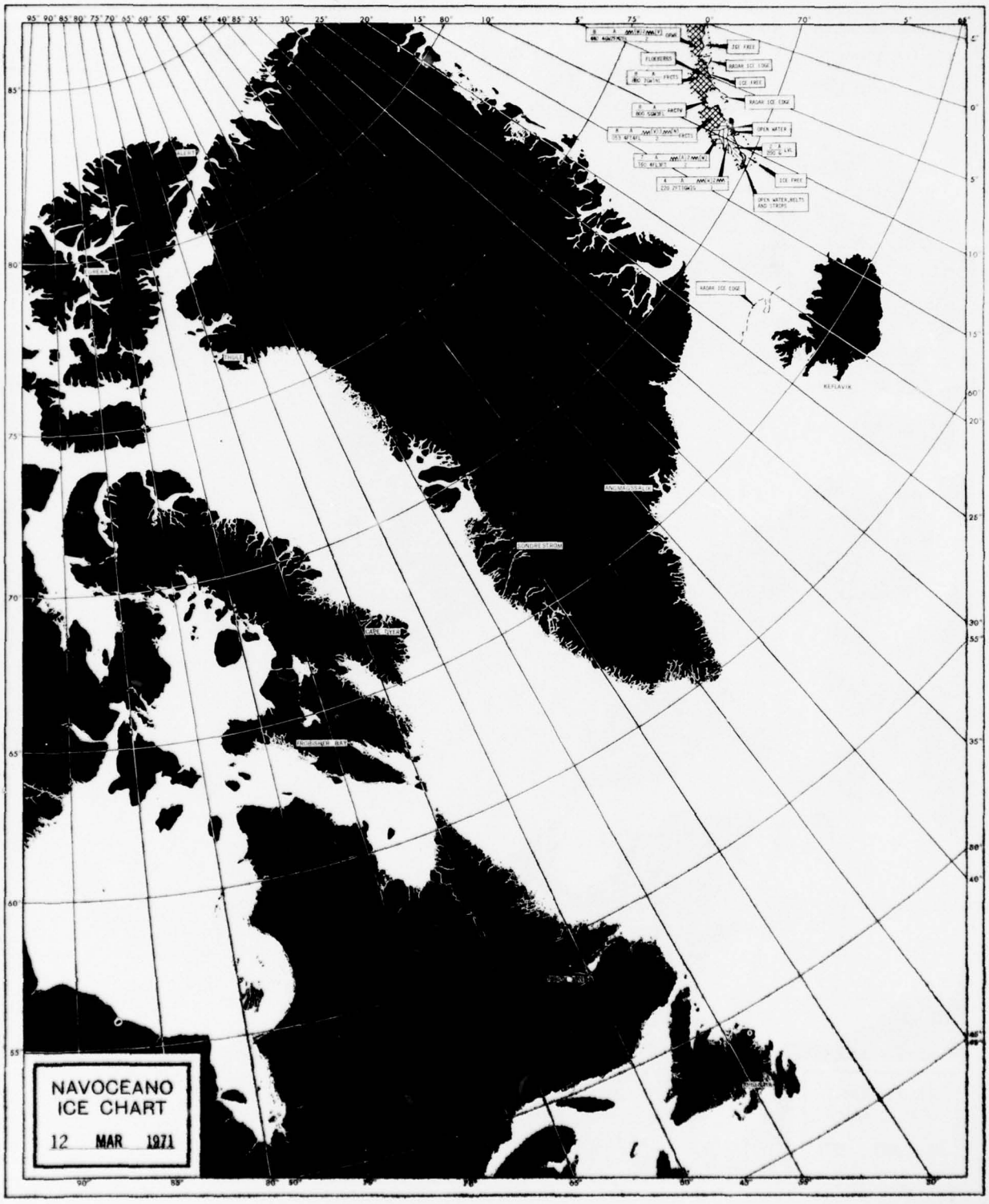
KEFLAVIK
CAPE DYER
FROBISHER BAY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ICE CHART
12 MAR 1971
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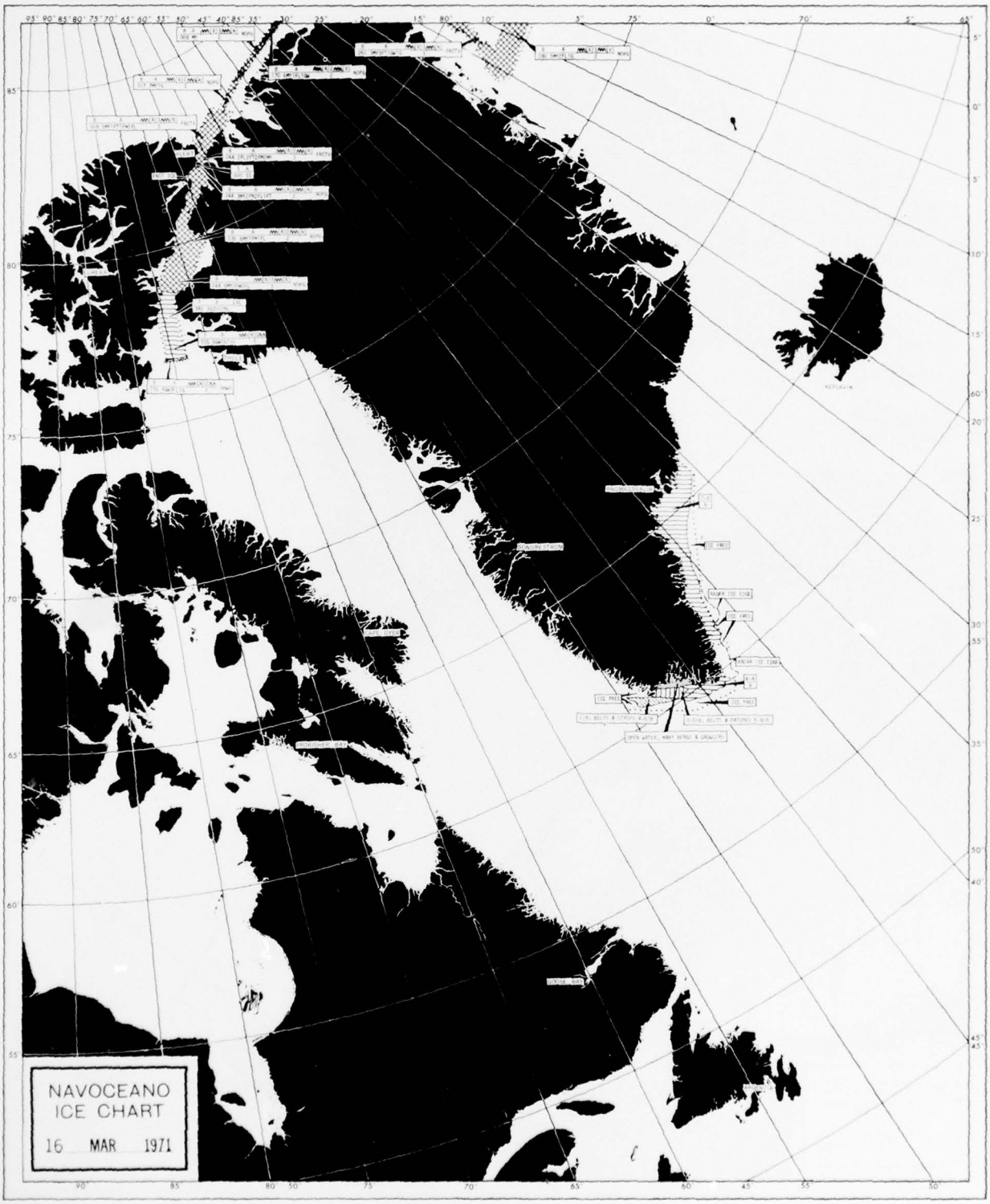
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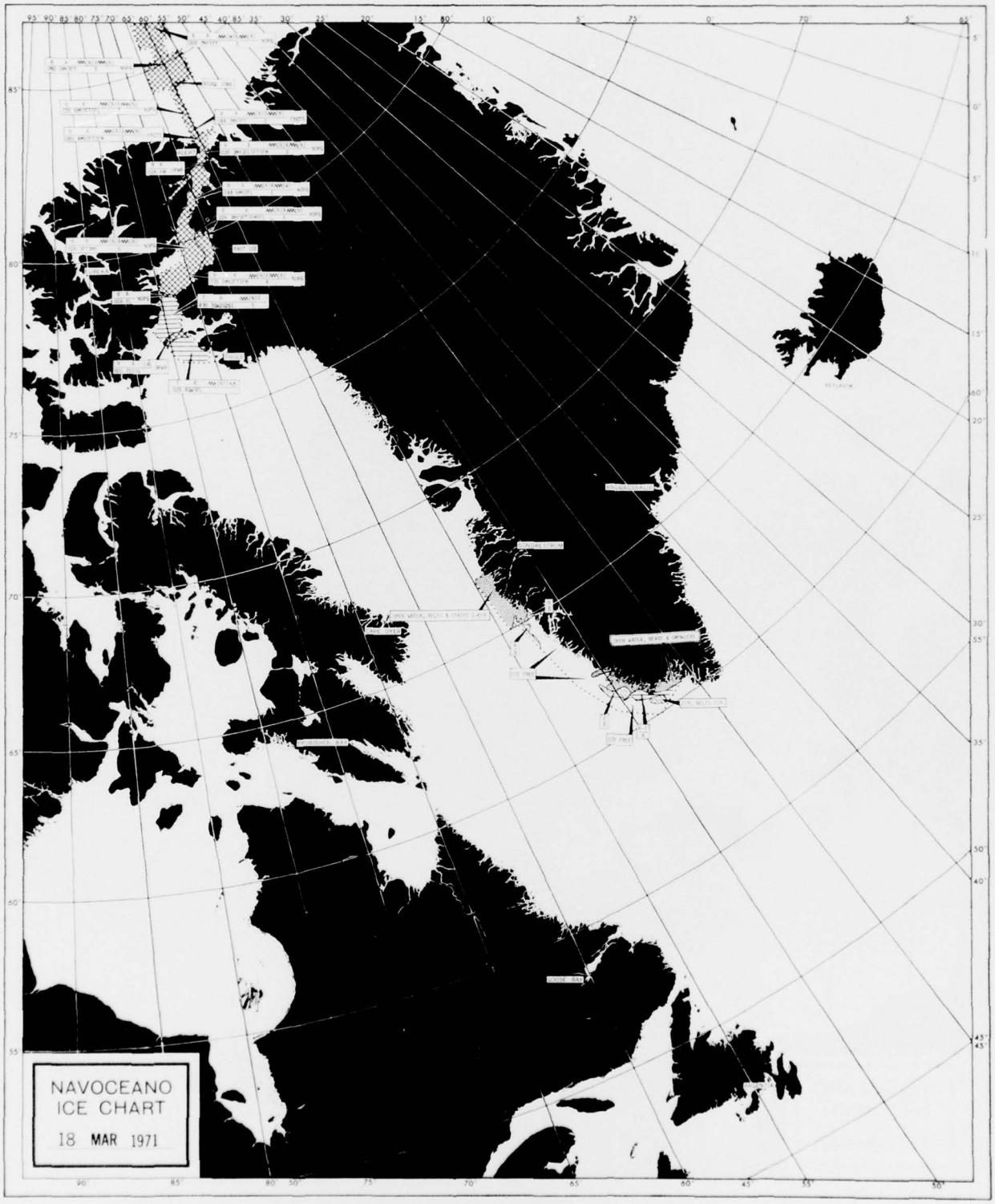
16 MAR 1971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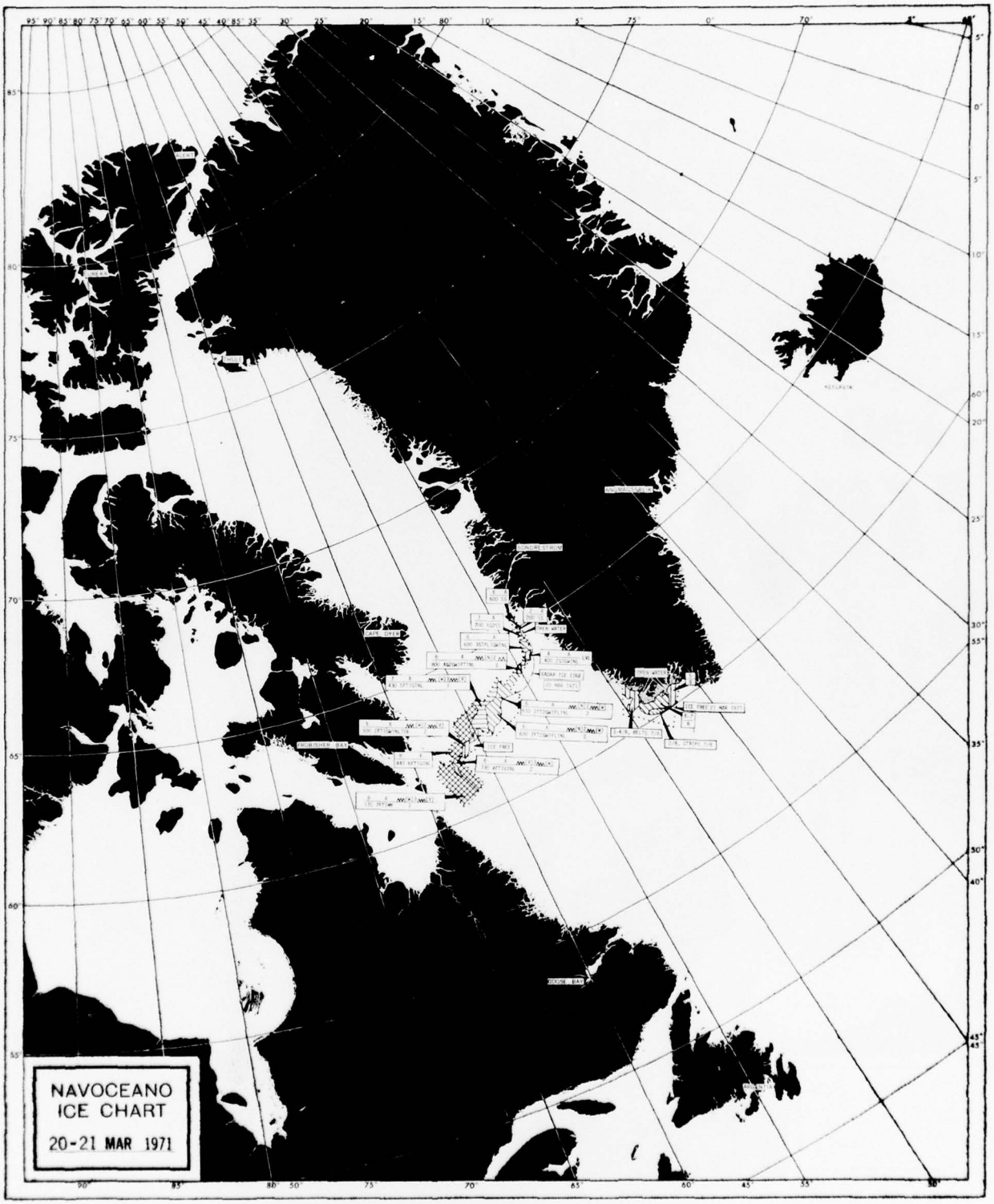
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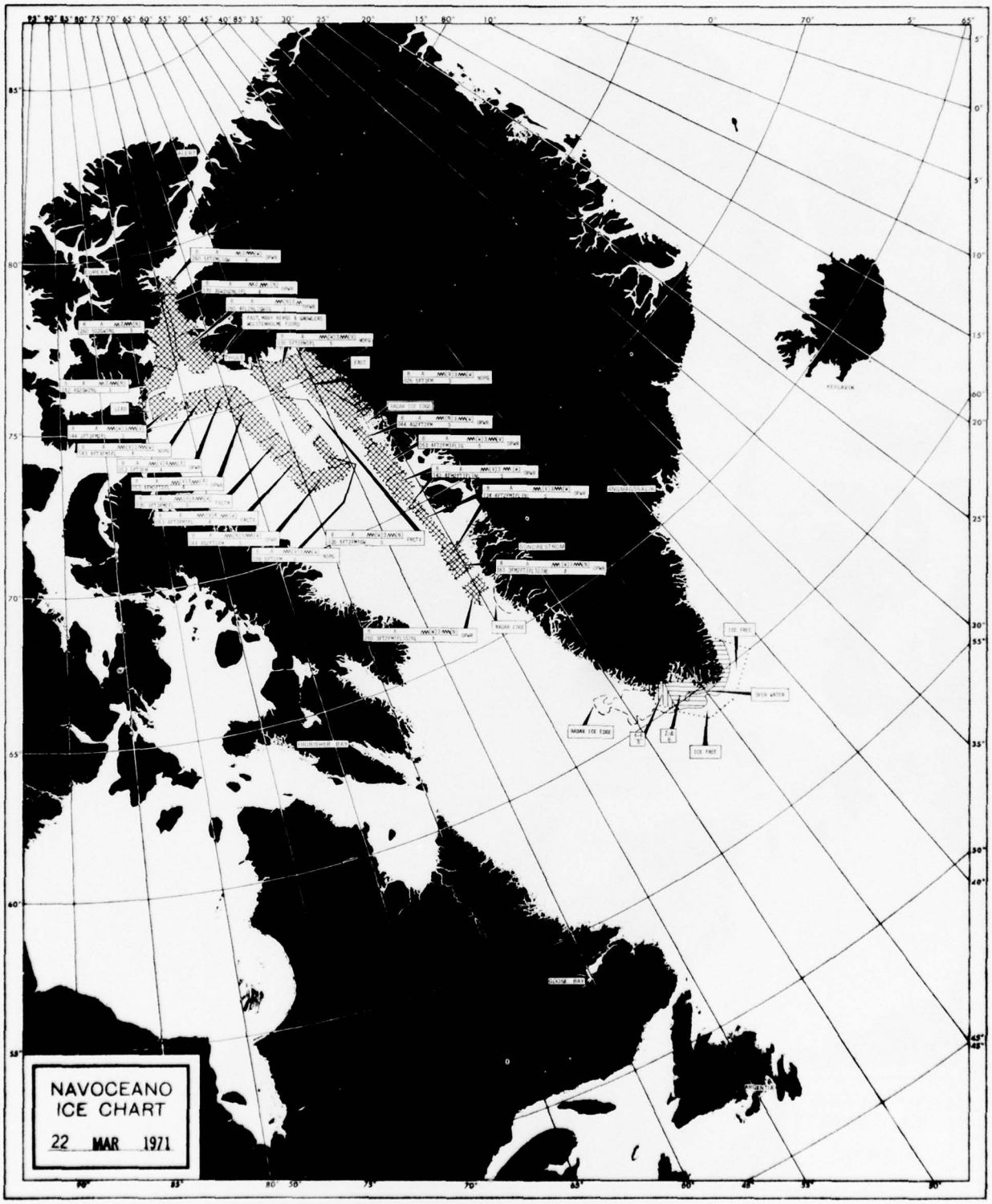
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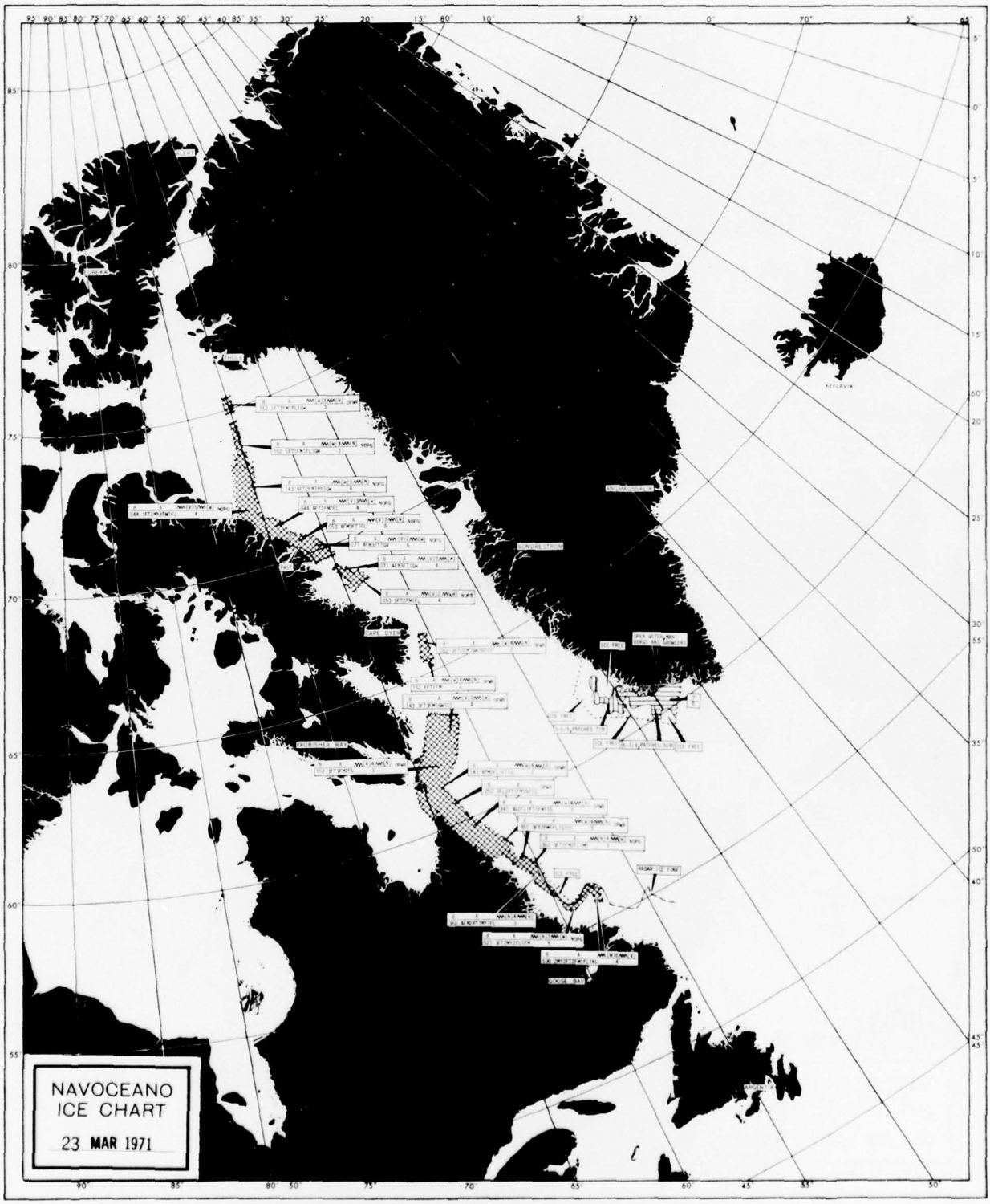
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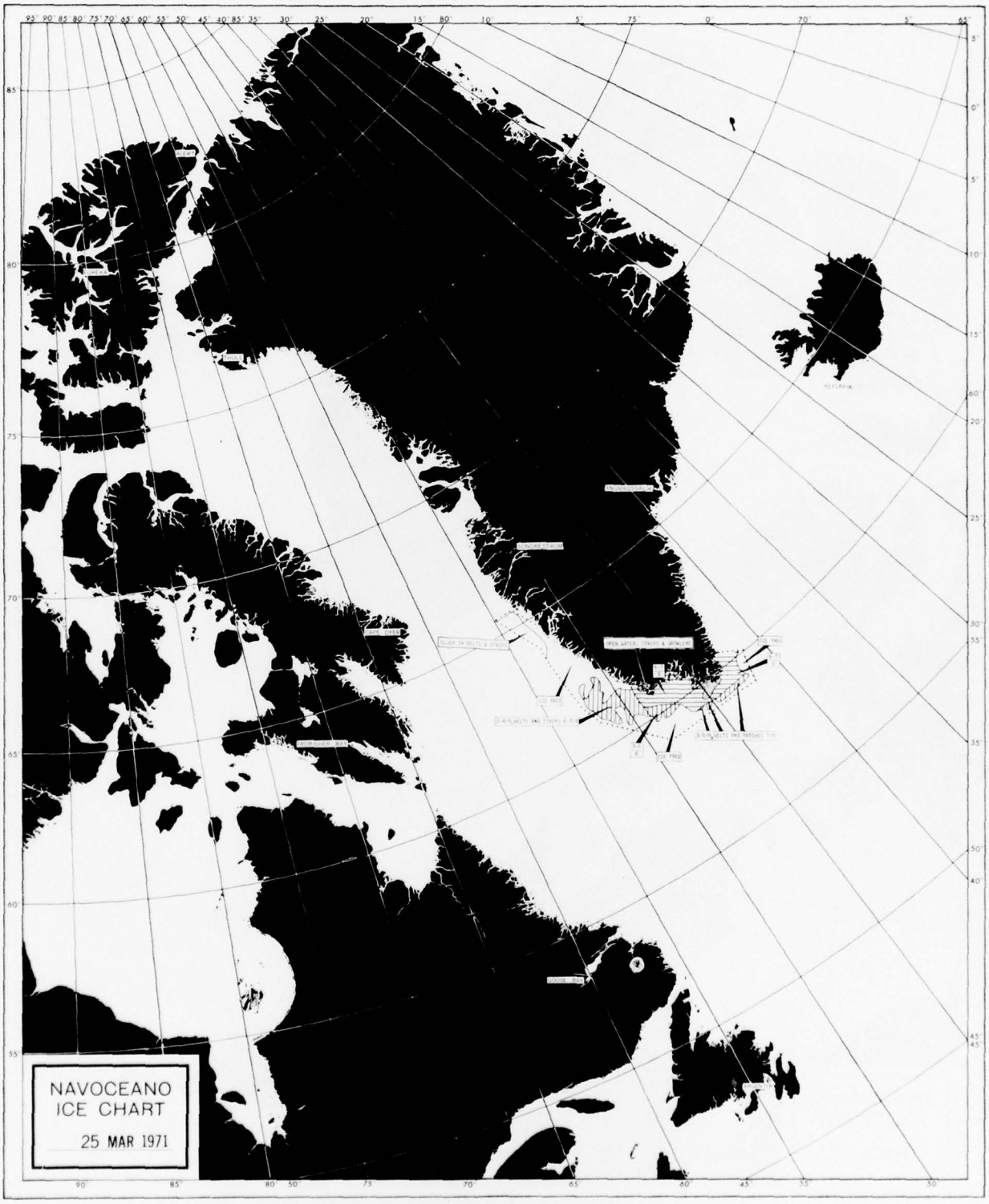
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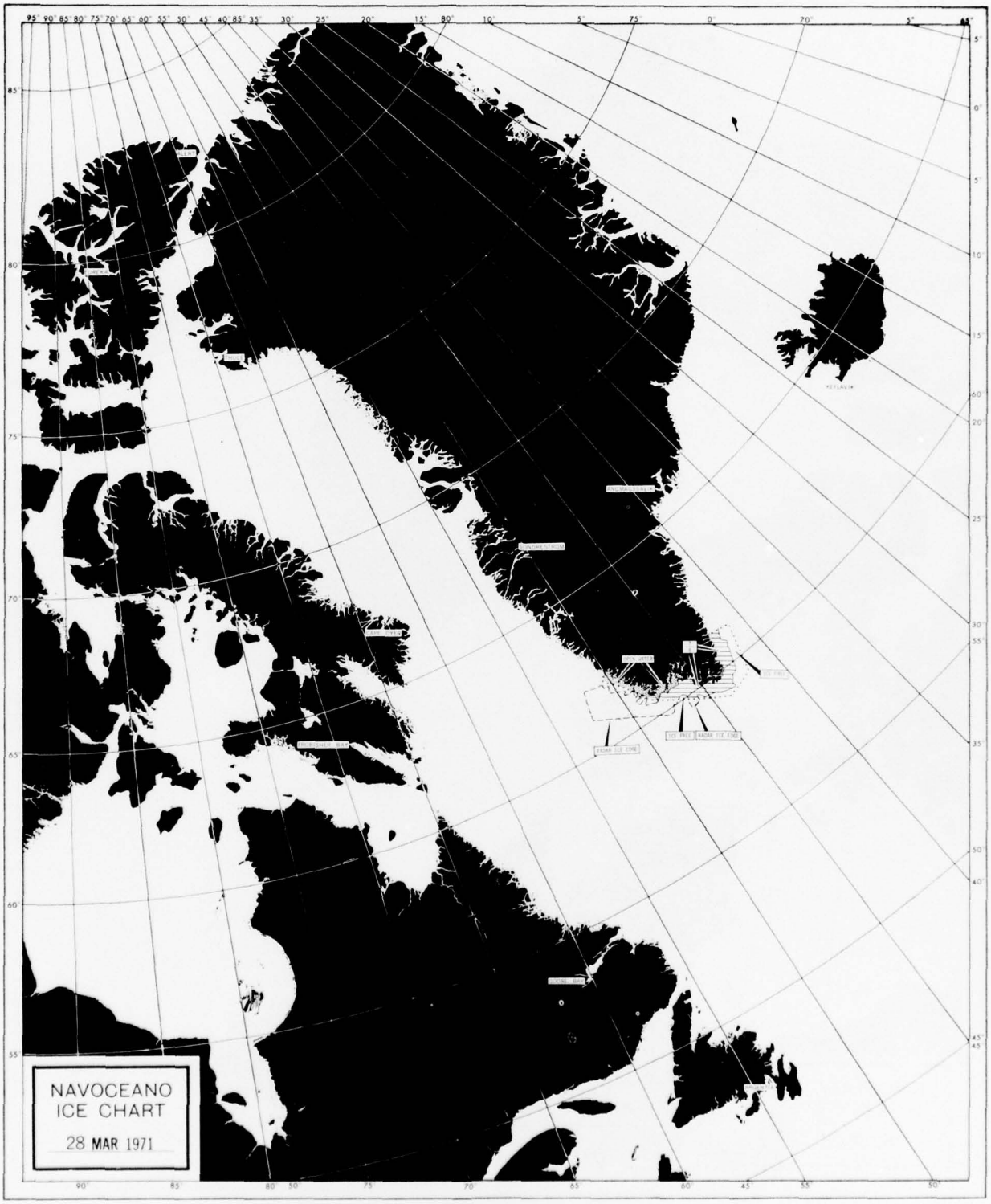
25 MAR 1971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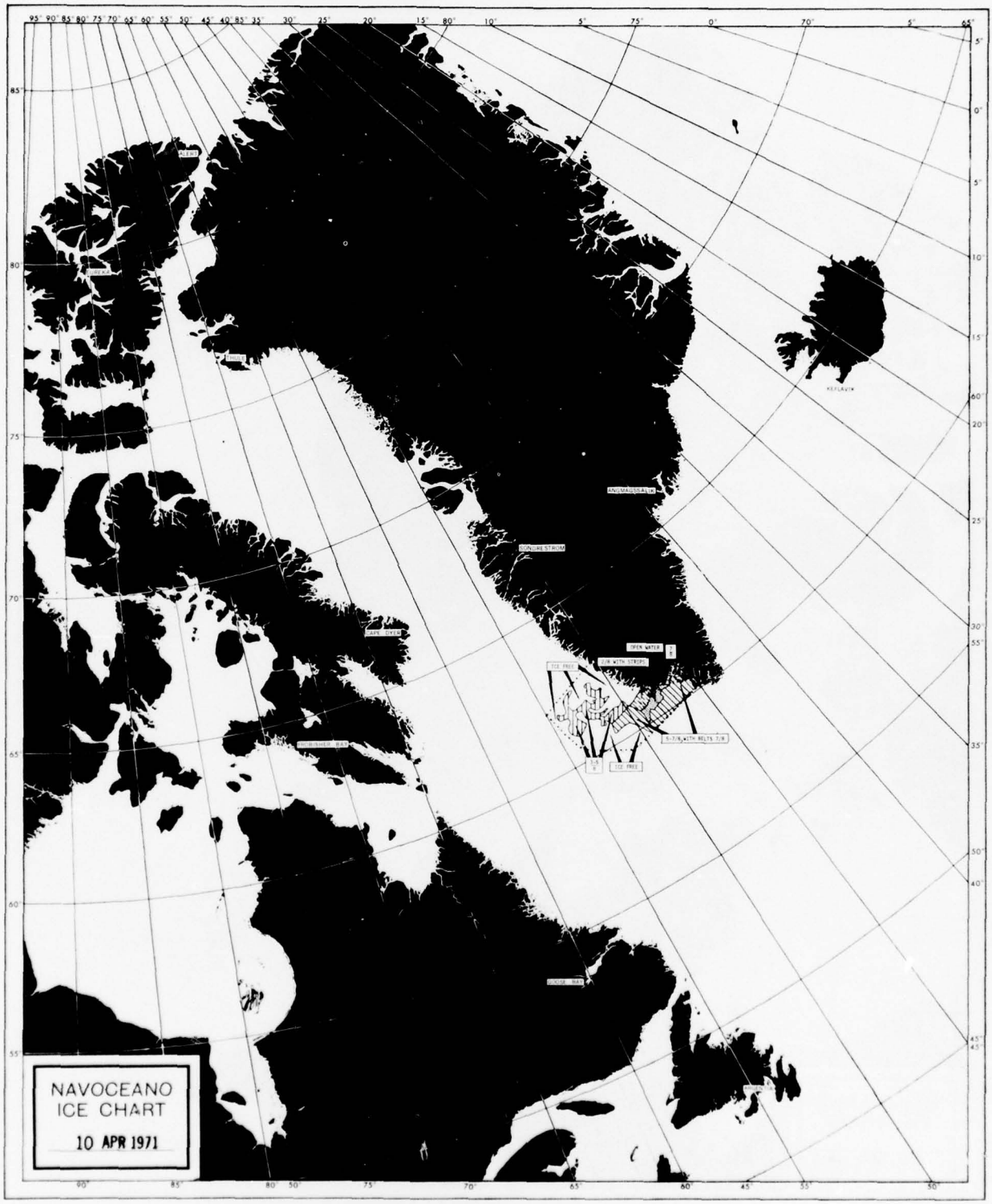
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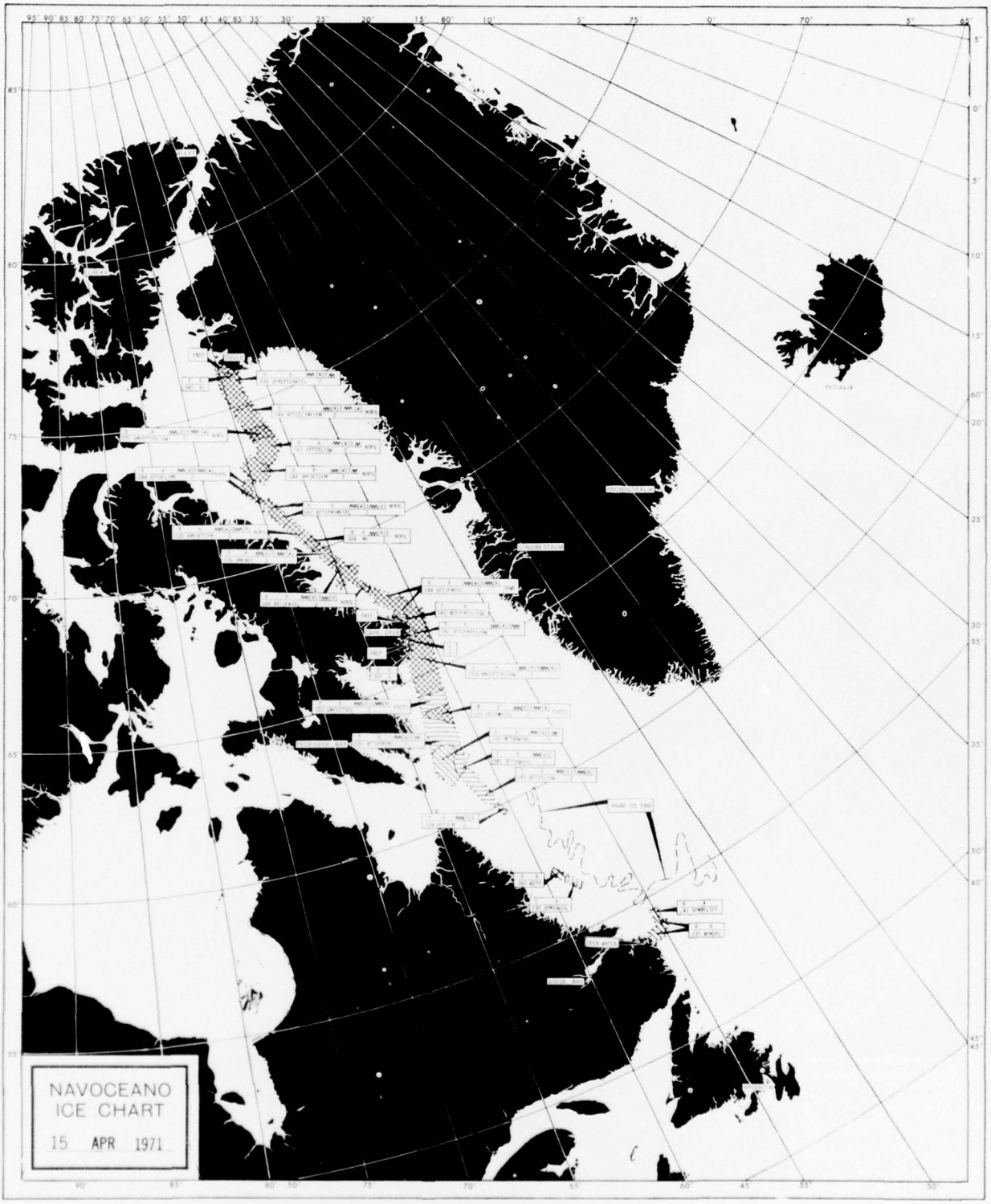
ICE CHART
10 APR 1971


NAVOCEANO
ICE CHART
13-14 APR 1971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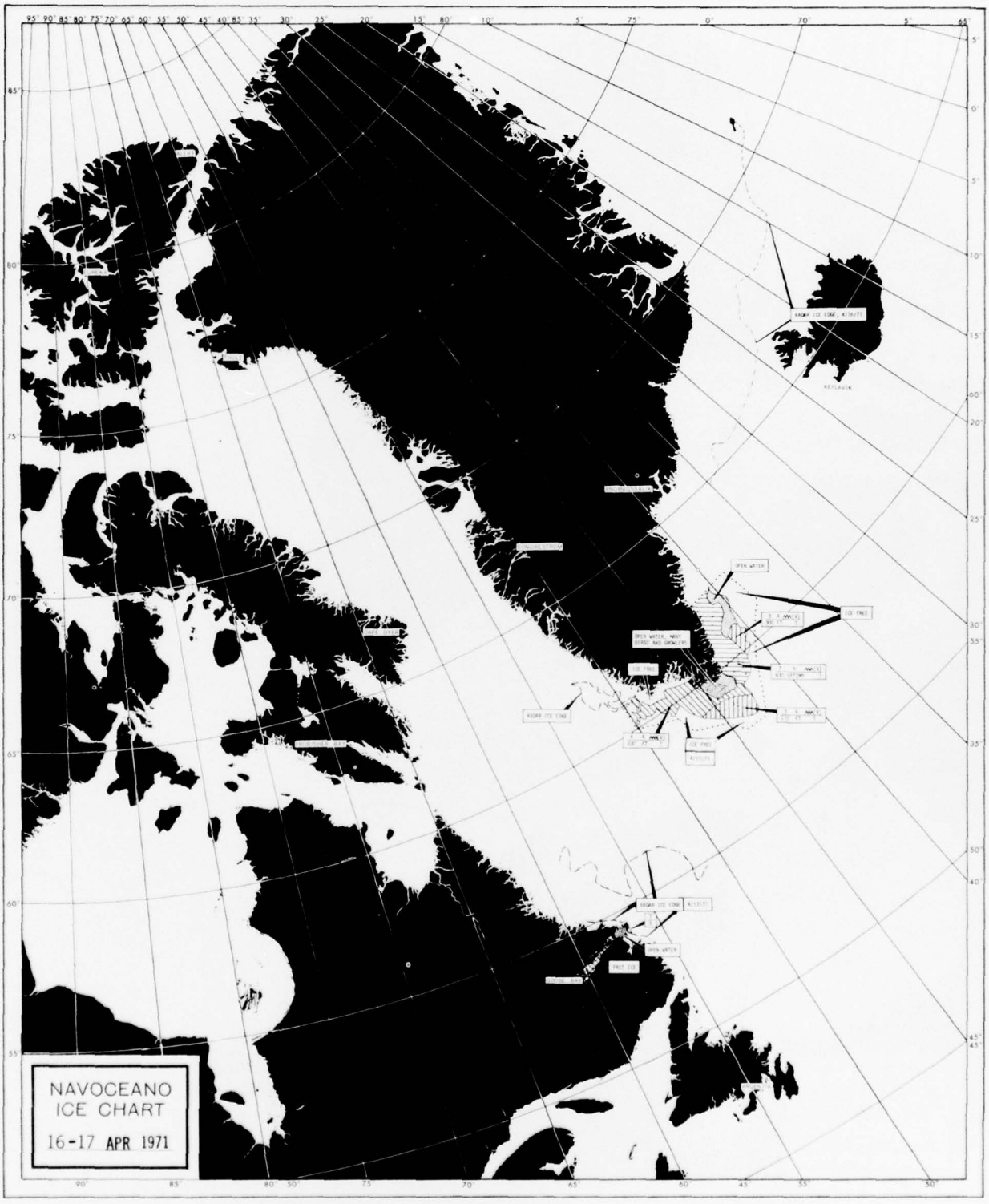
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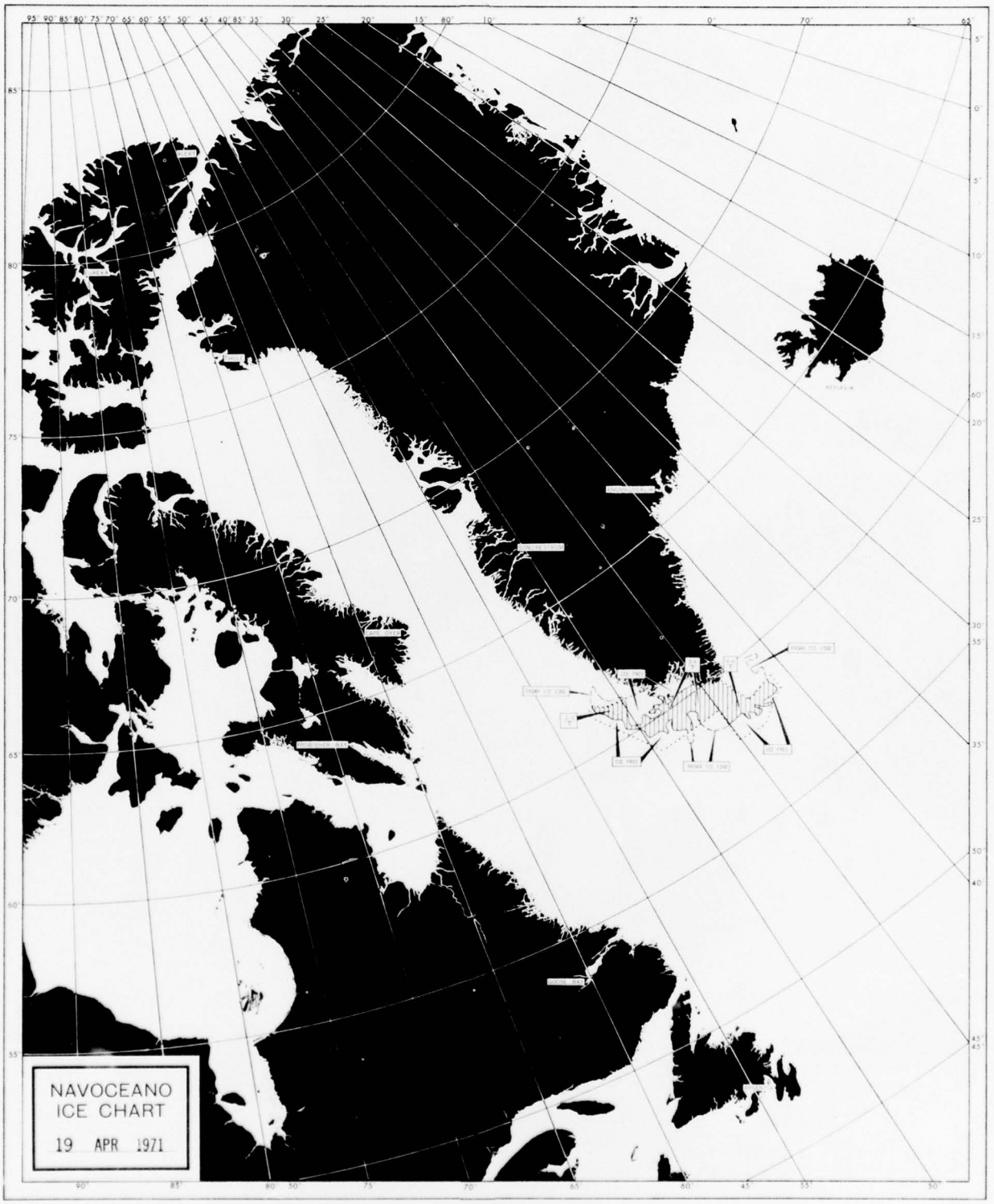
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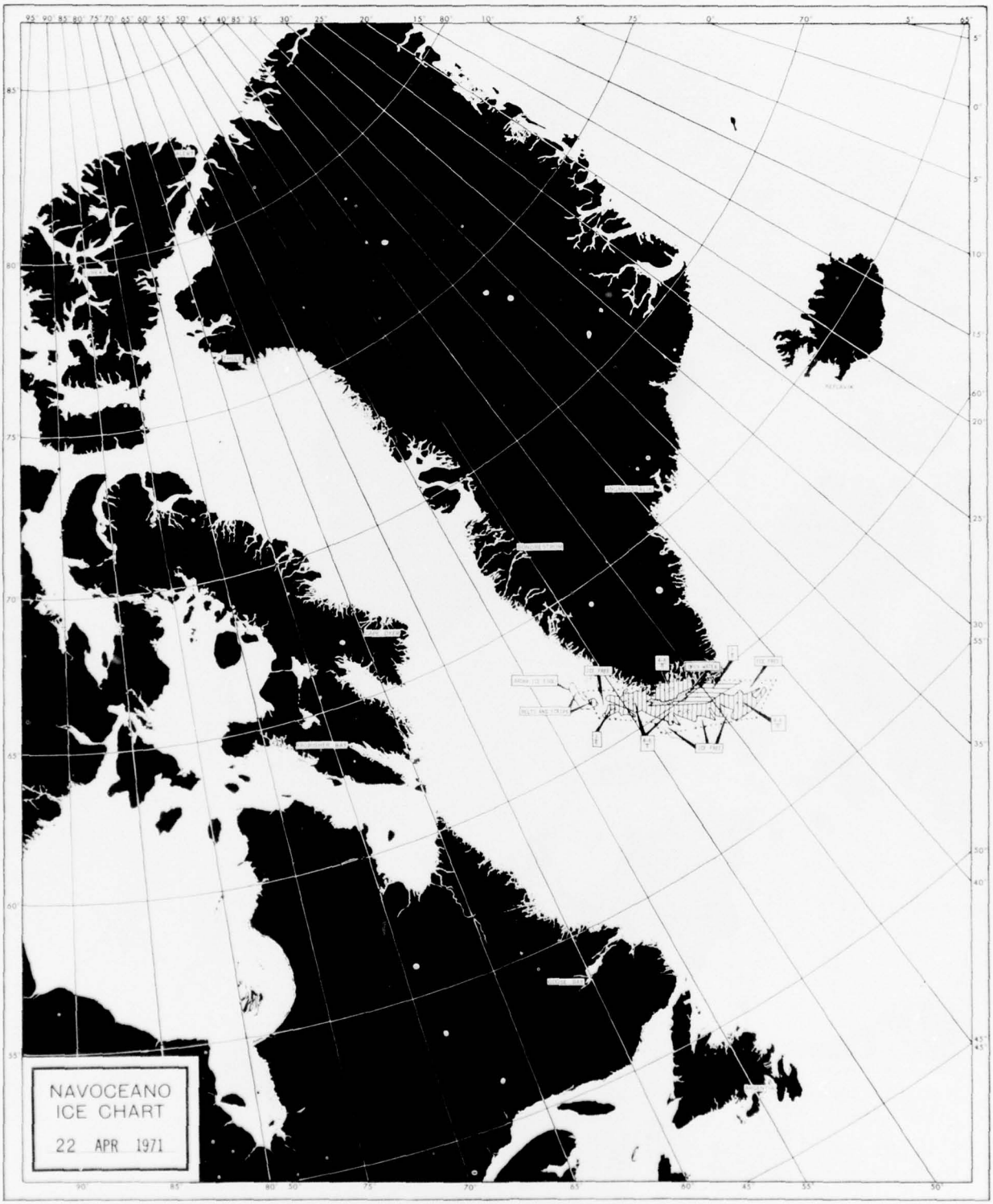
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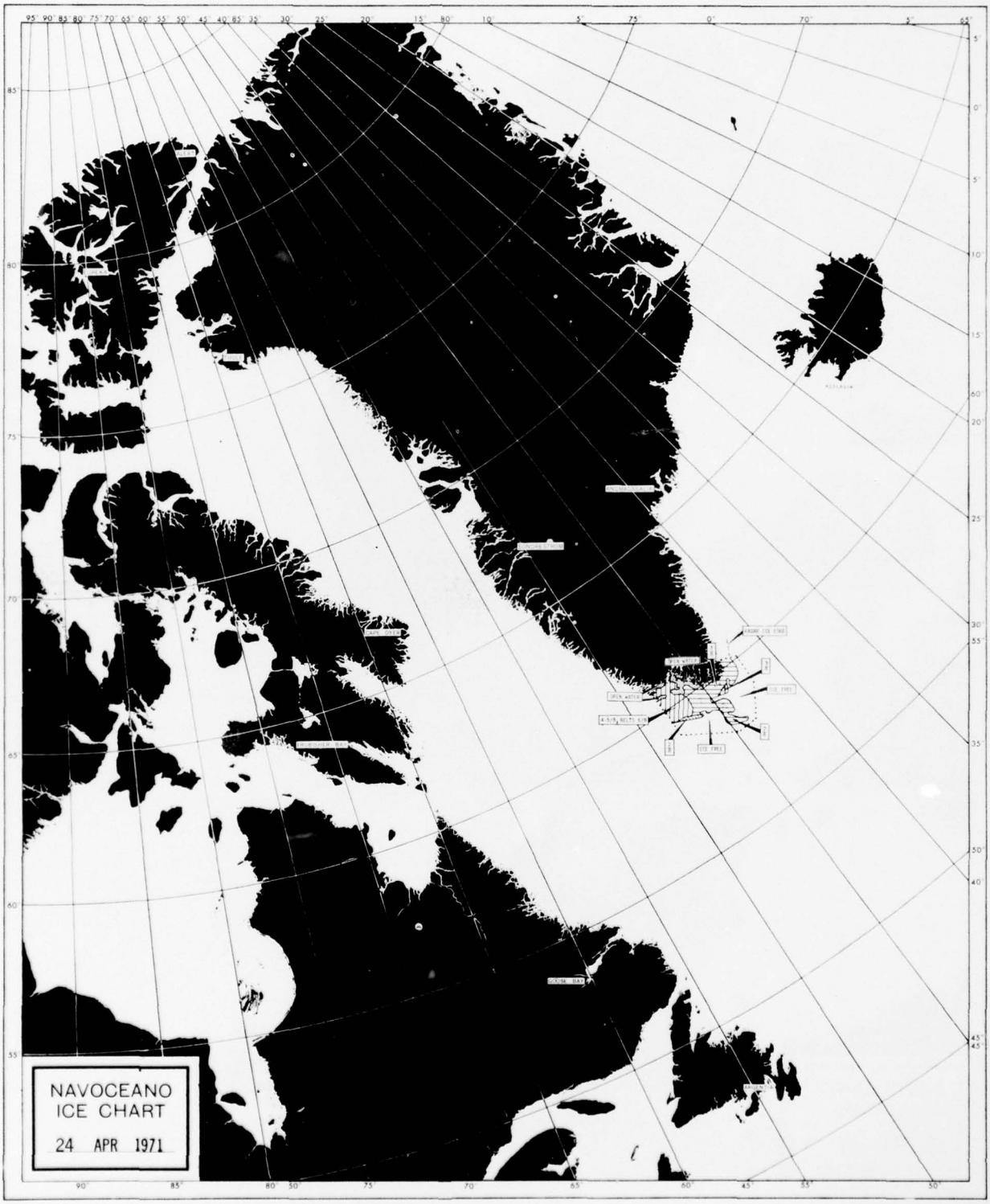
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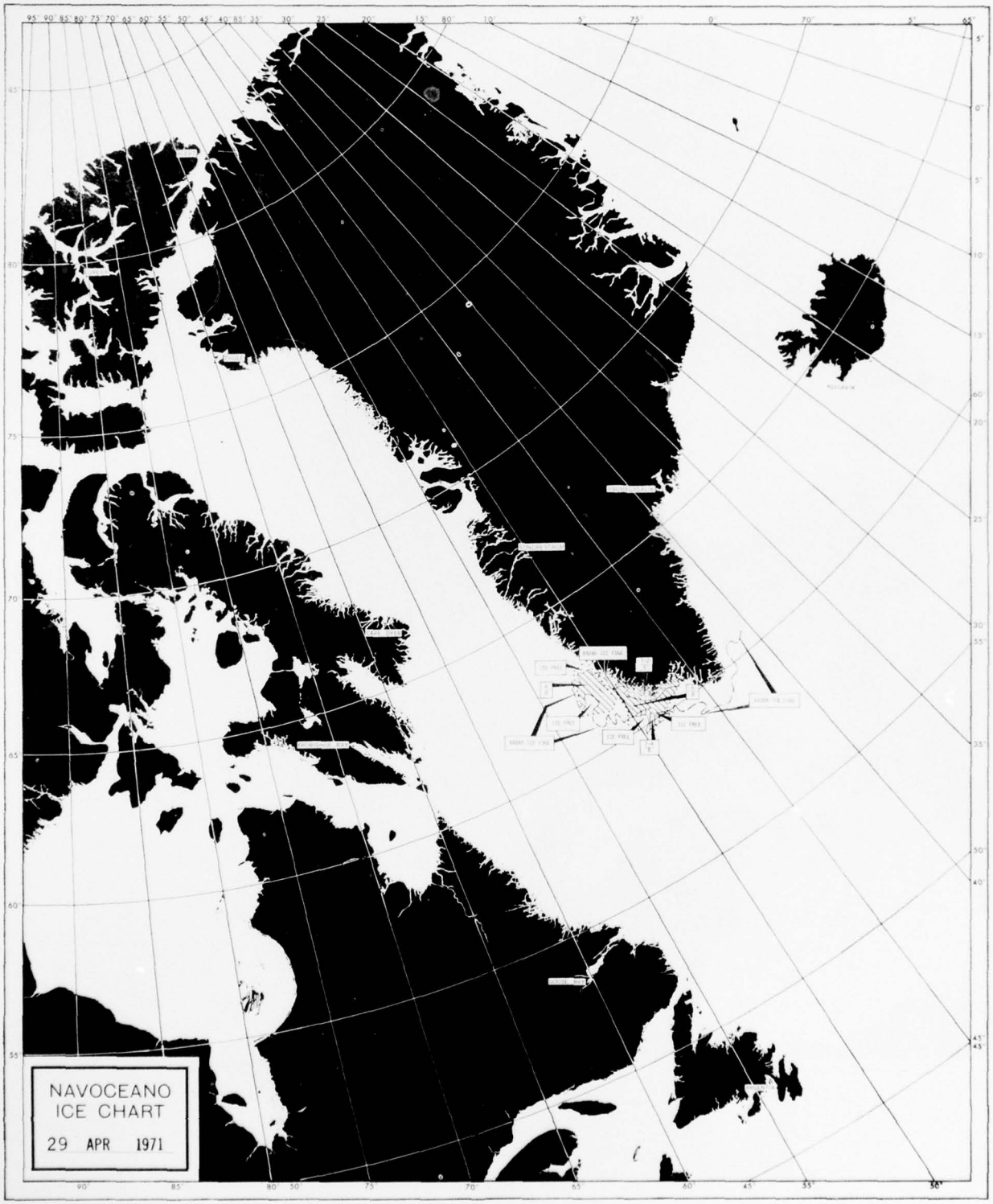
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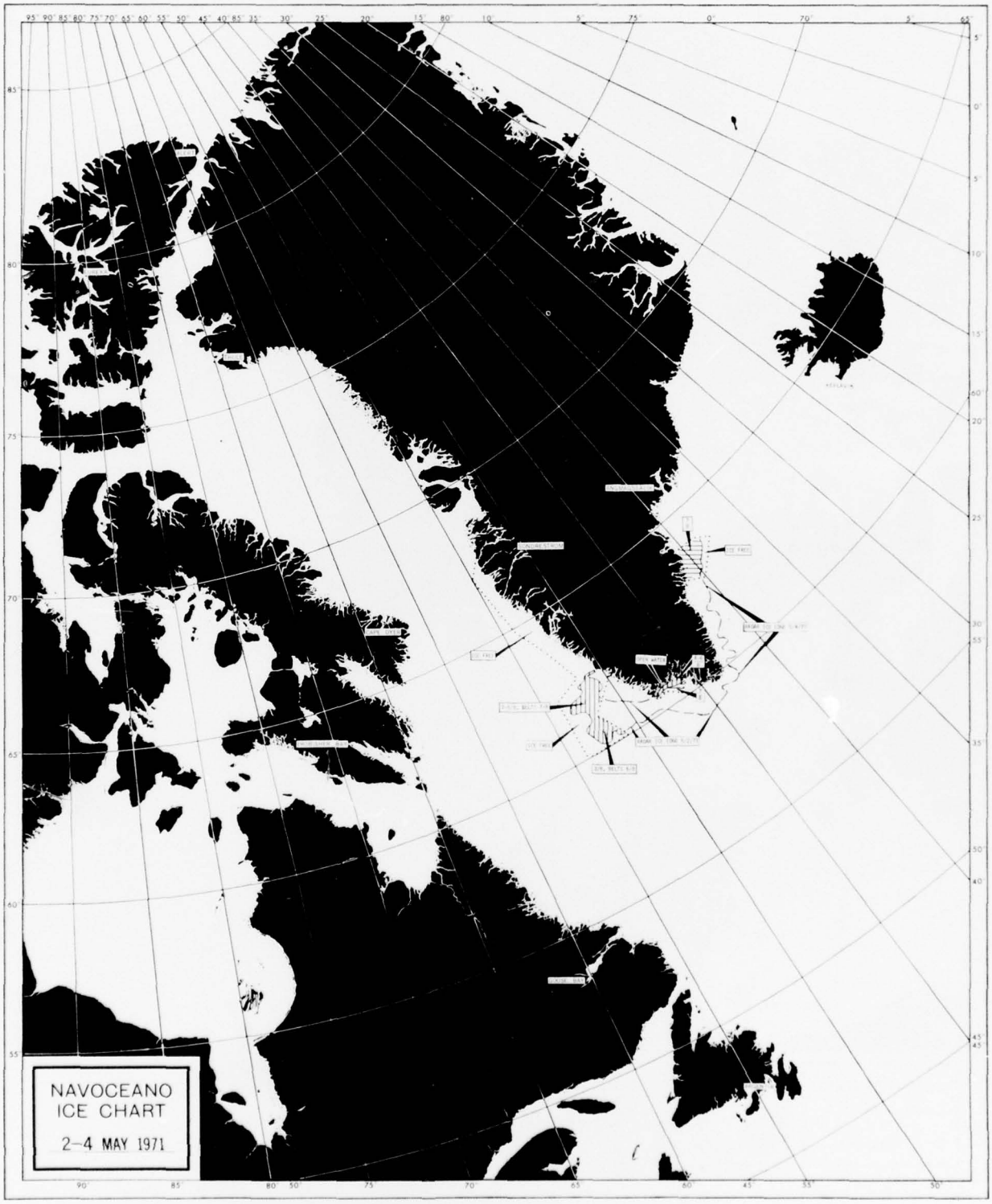
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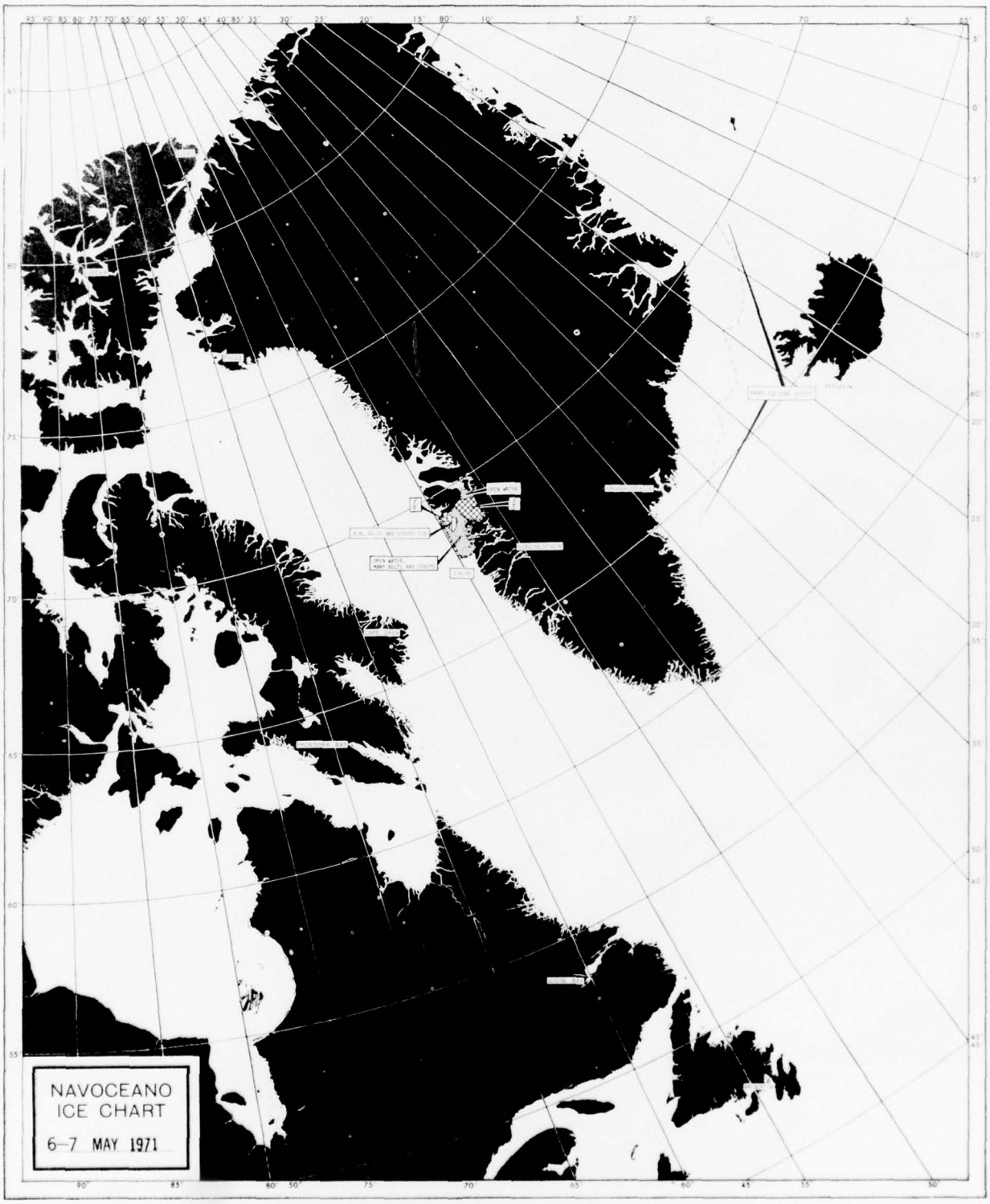
2–4 MAY 1971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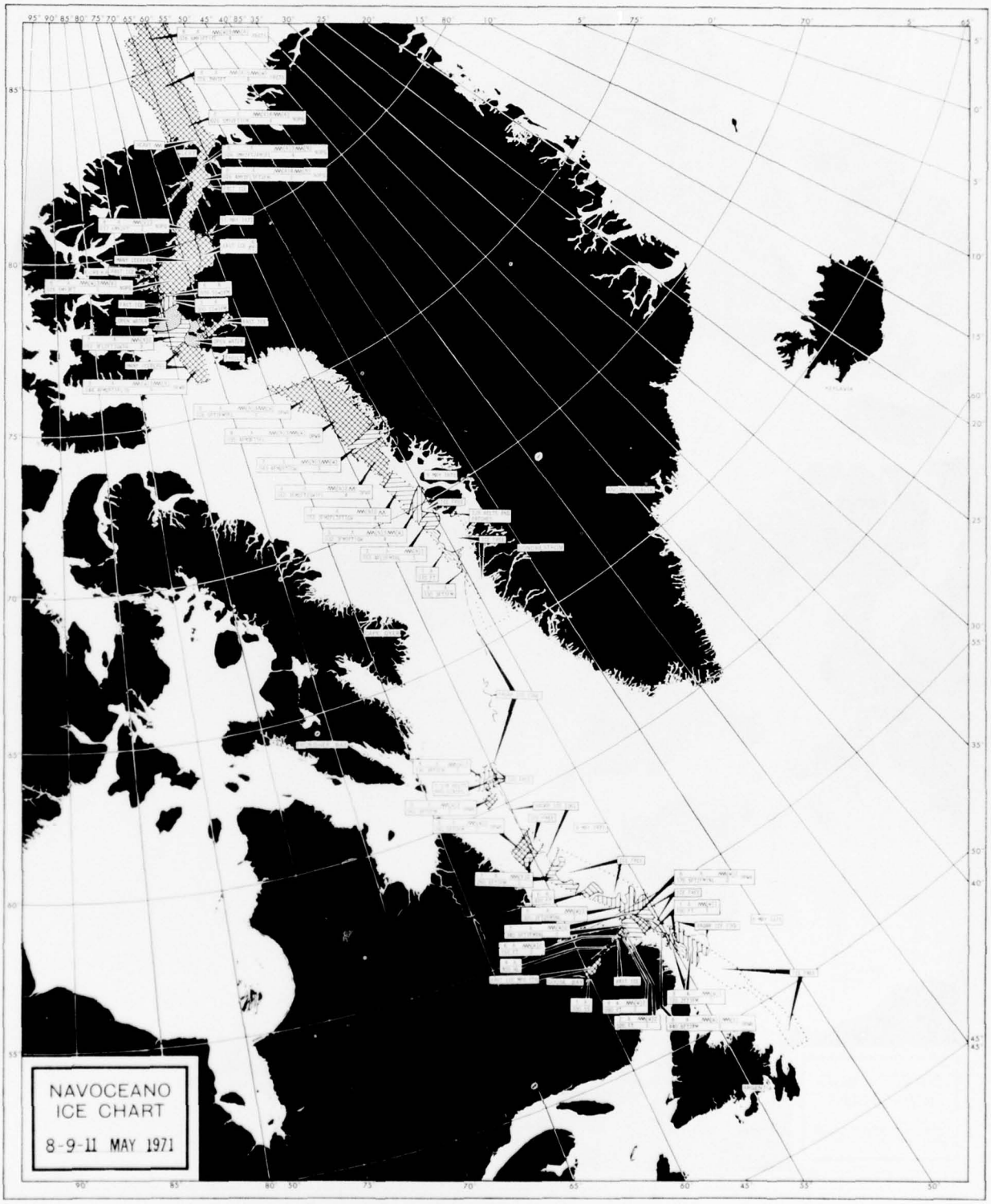
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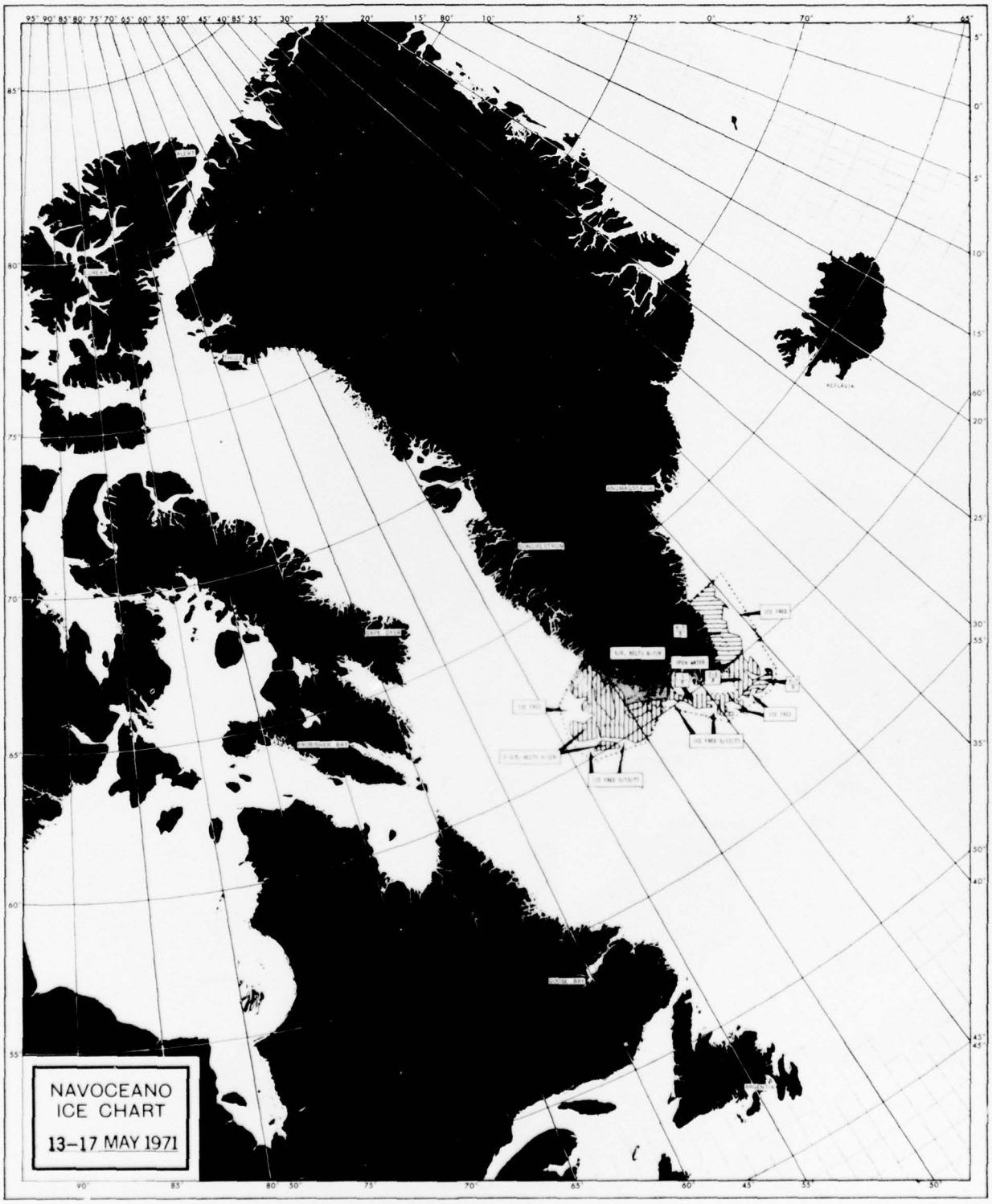
8-9-11 MAY 1971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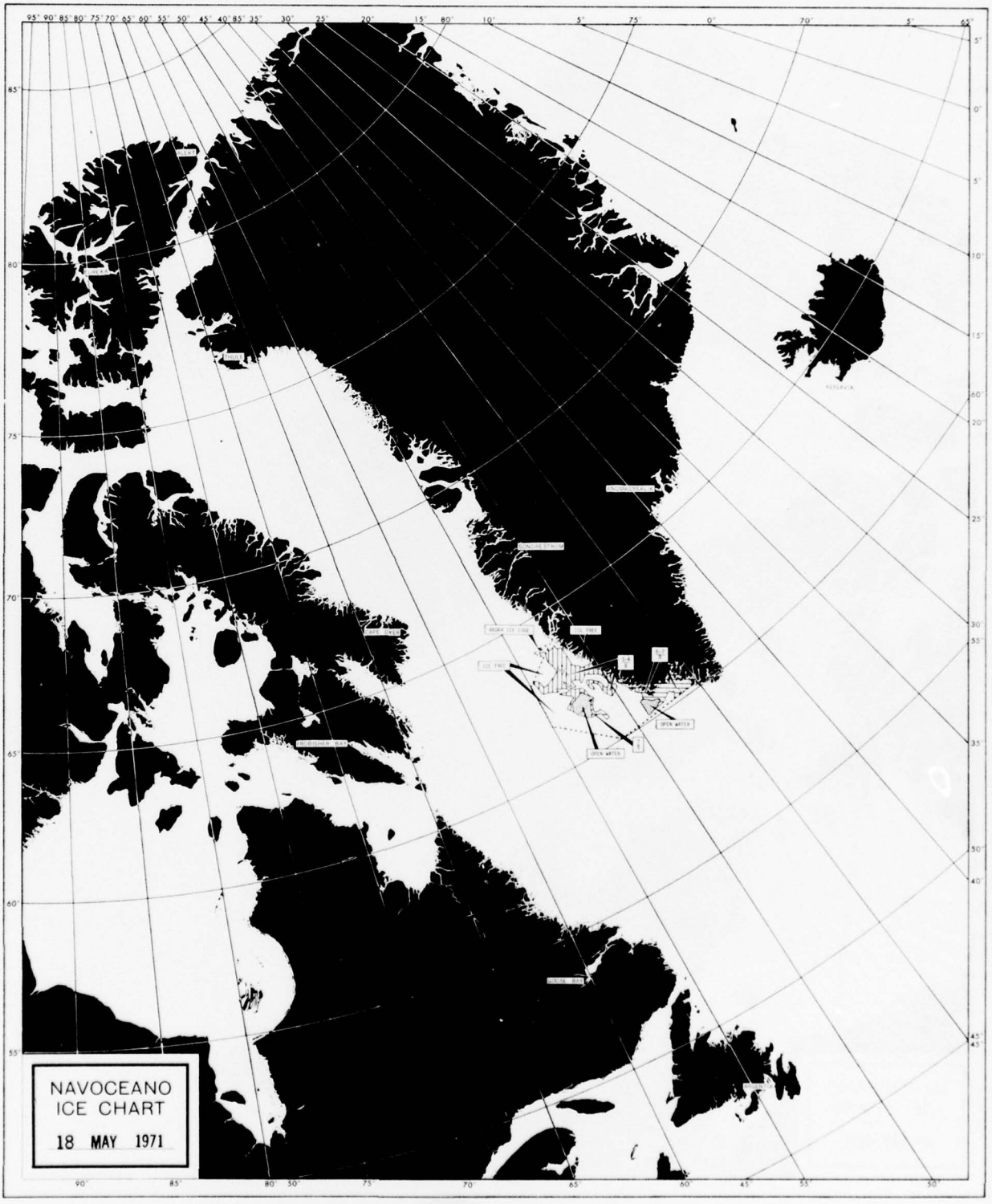
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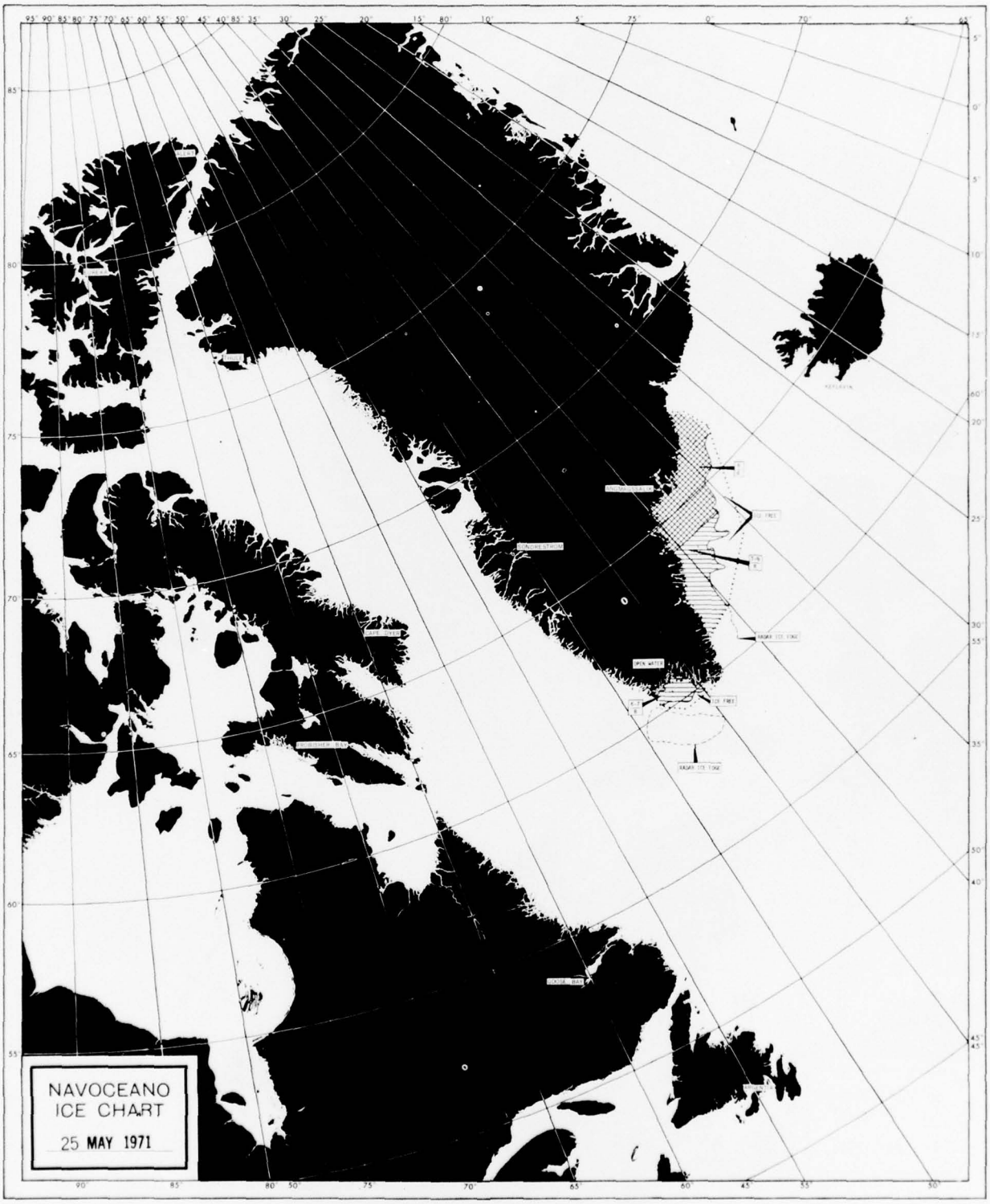
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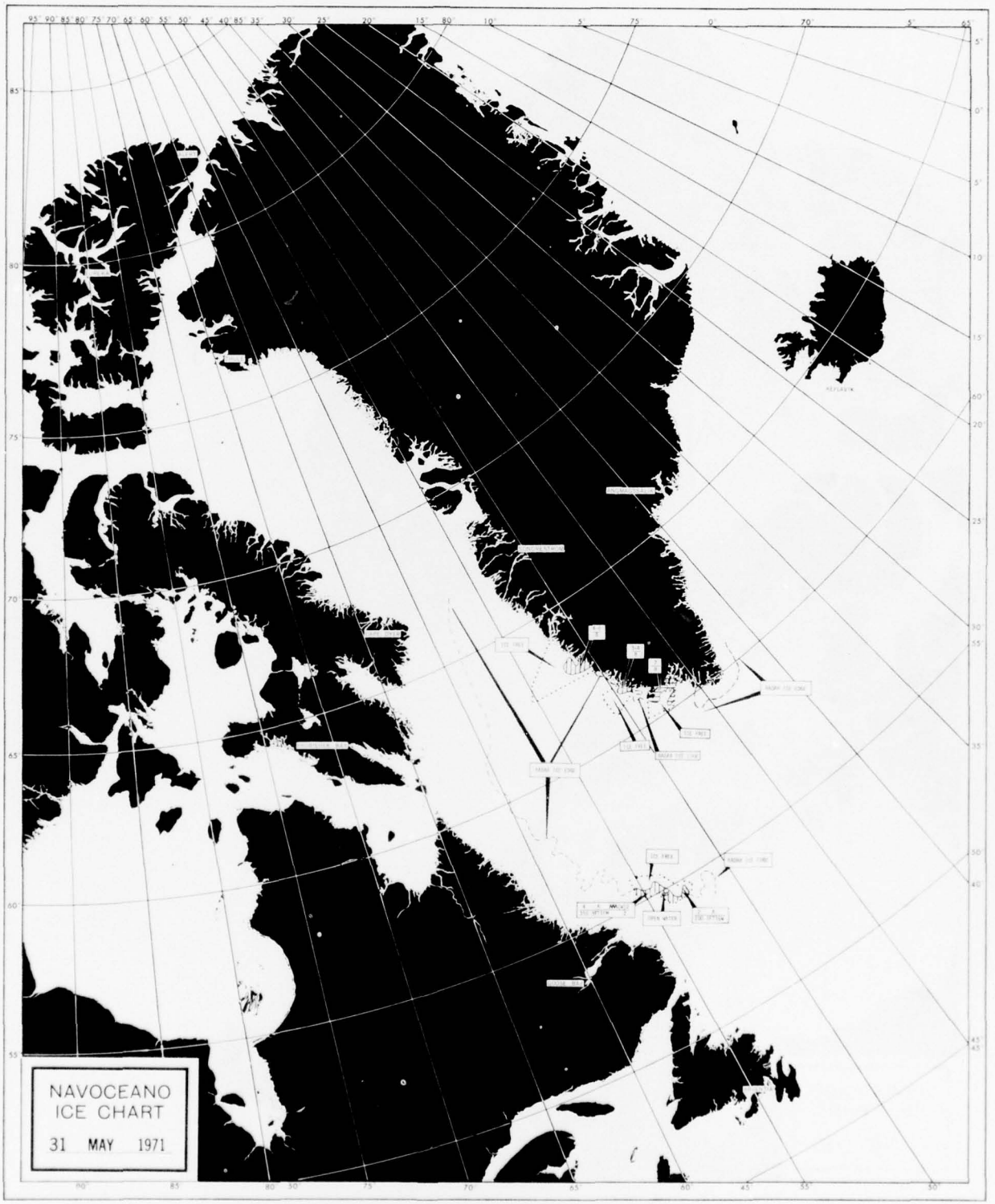
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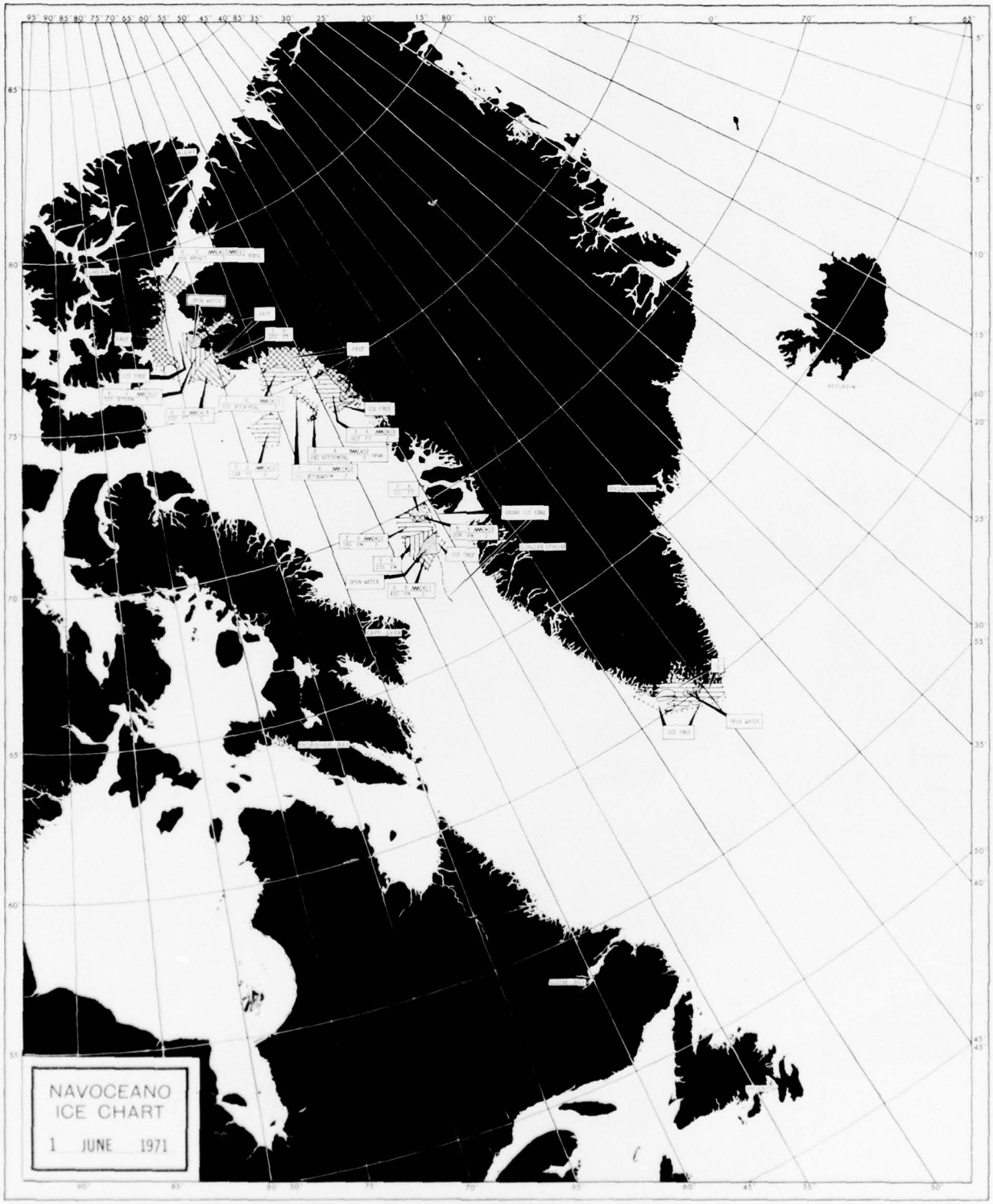
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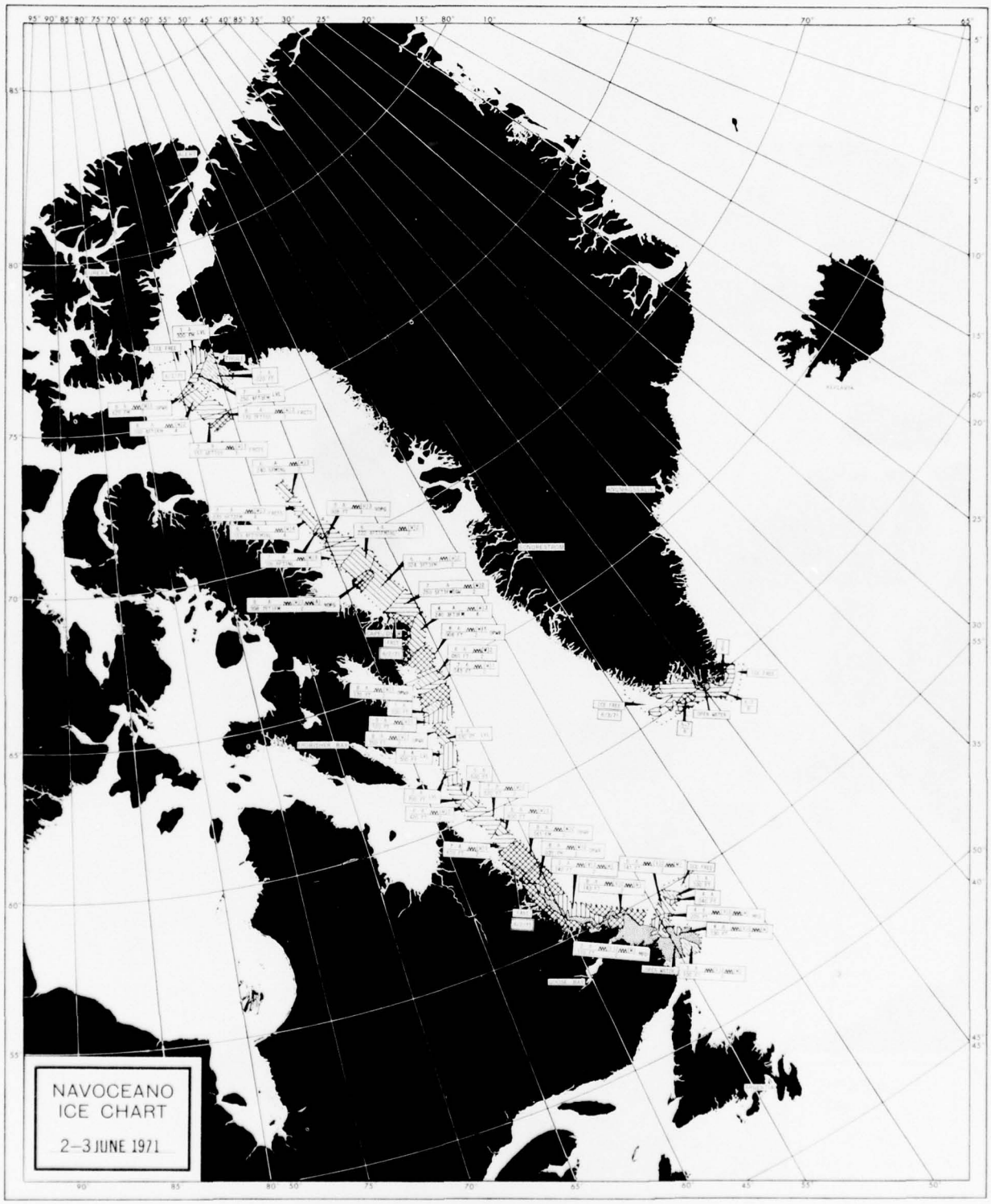
1 JUNE 1971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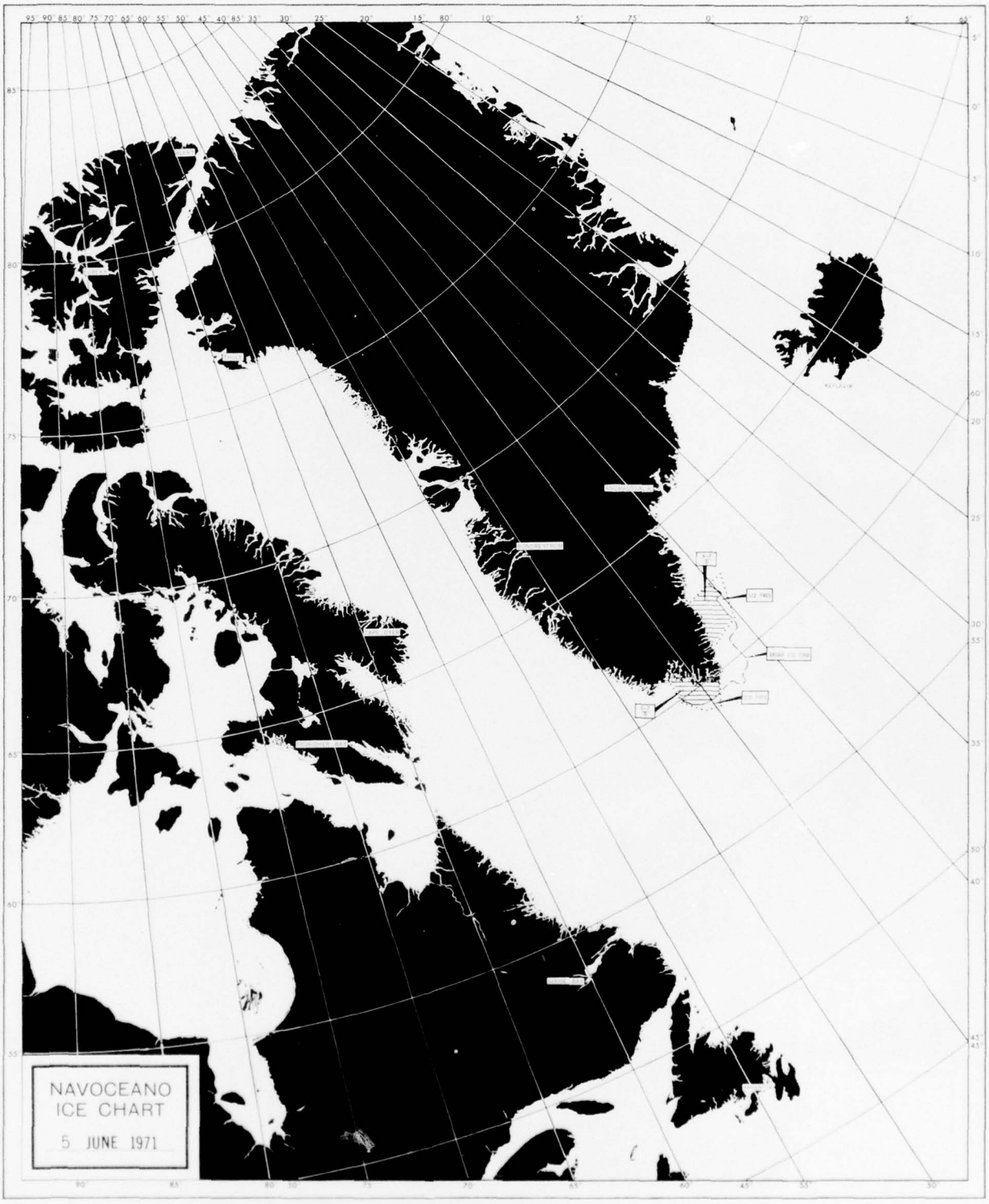
ICE CHART
2–3 JUNE 1971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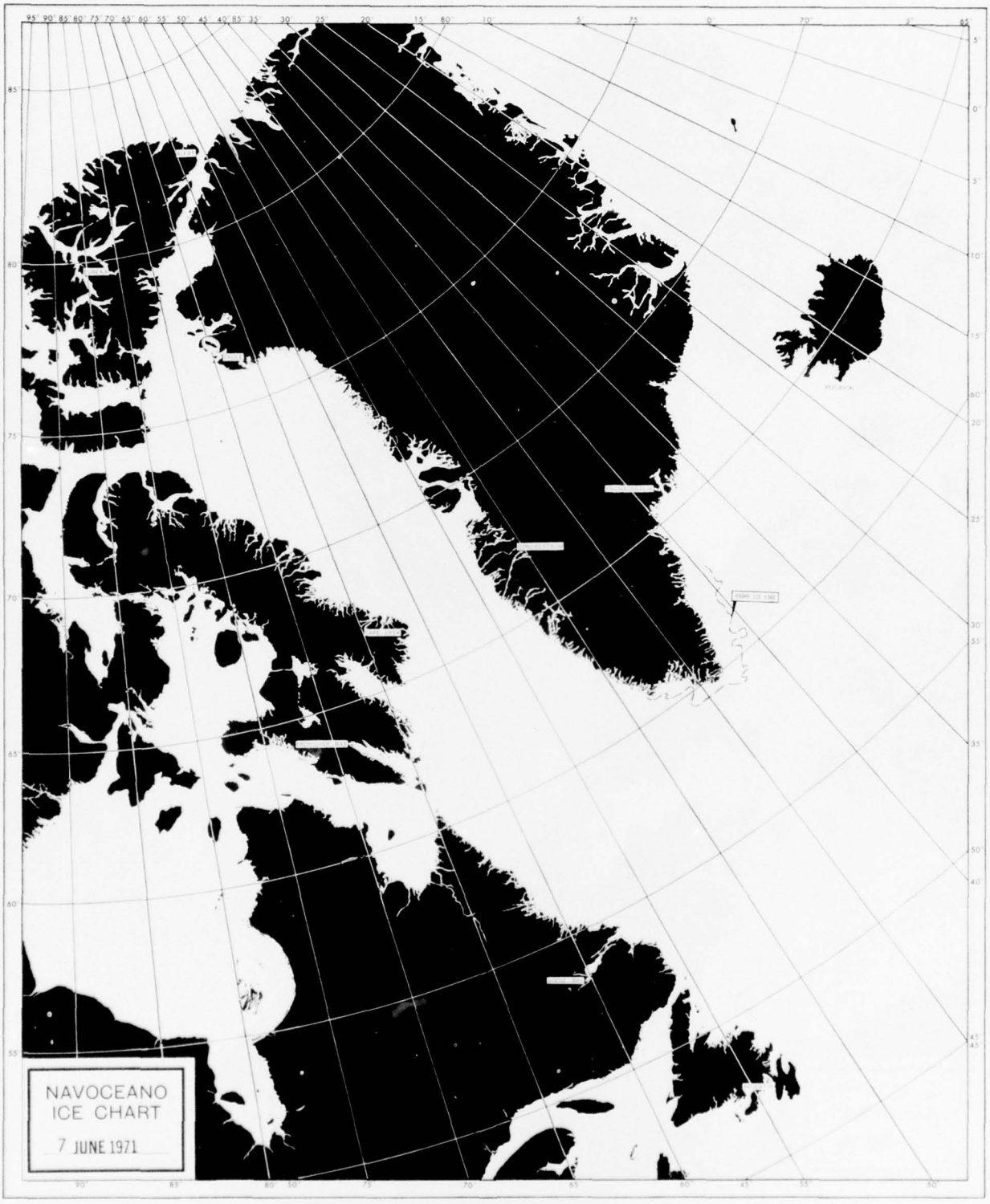
5 JUNE 1971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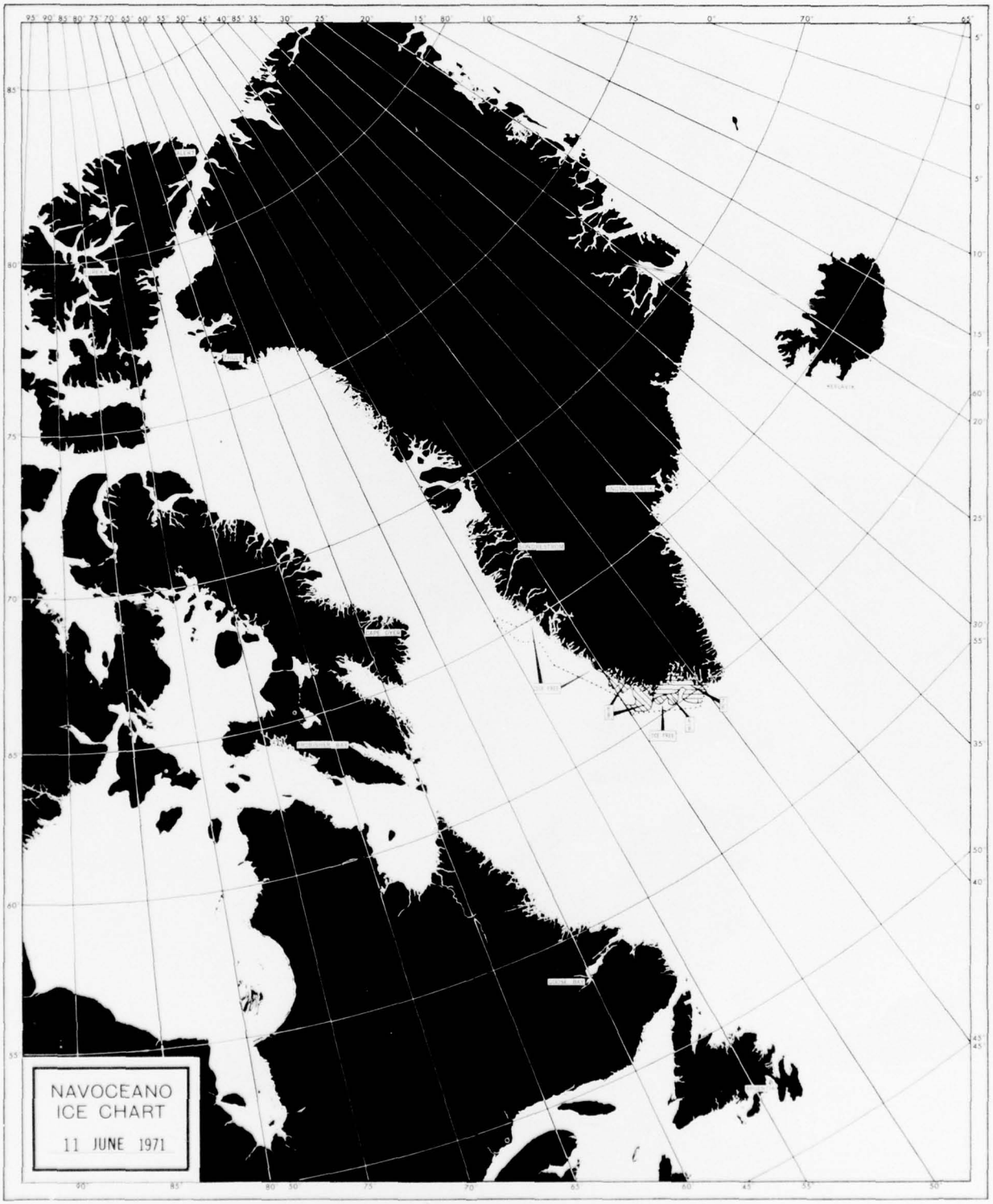
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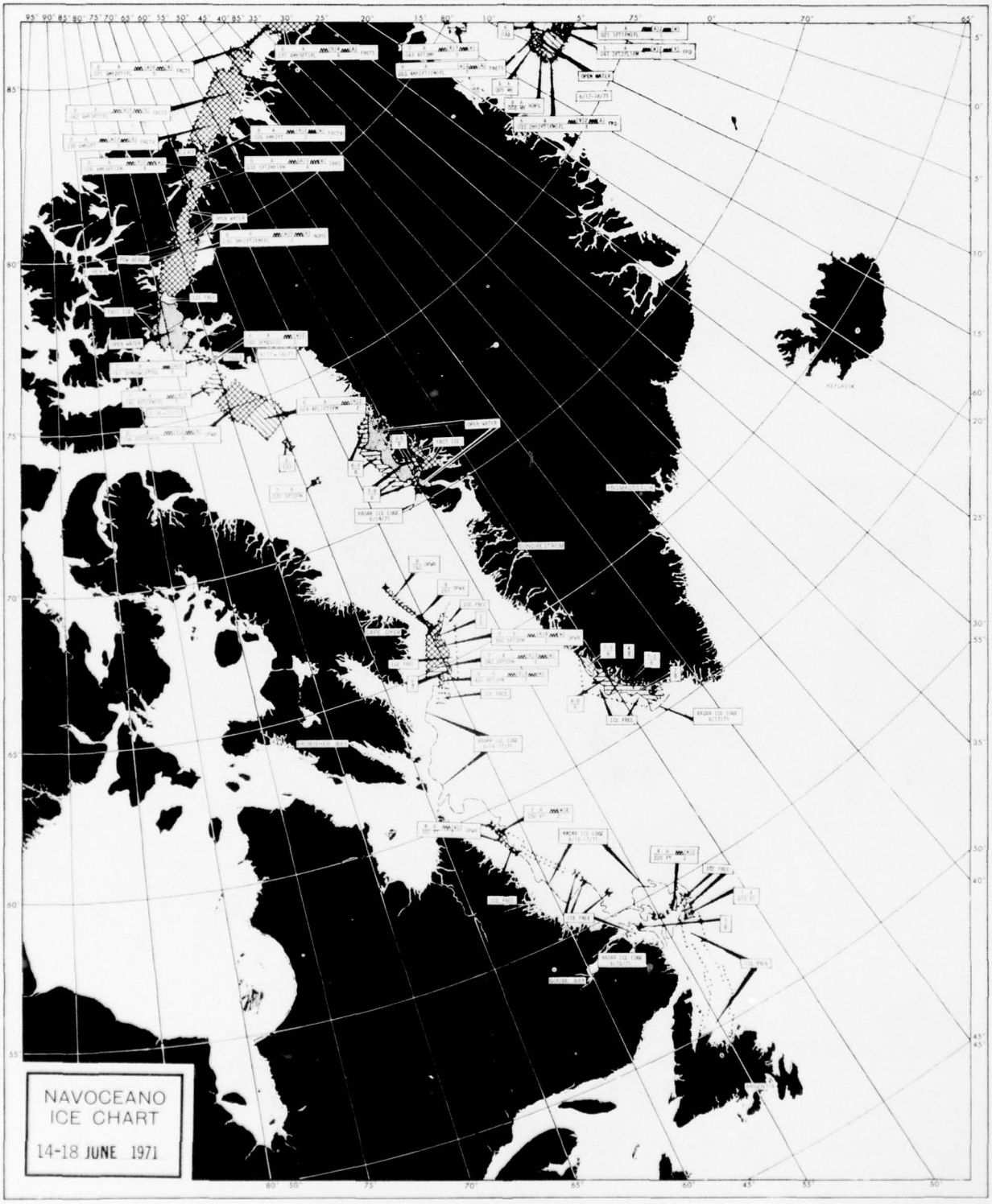
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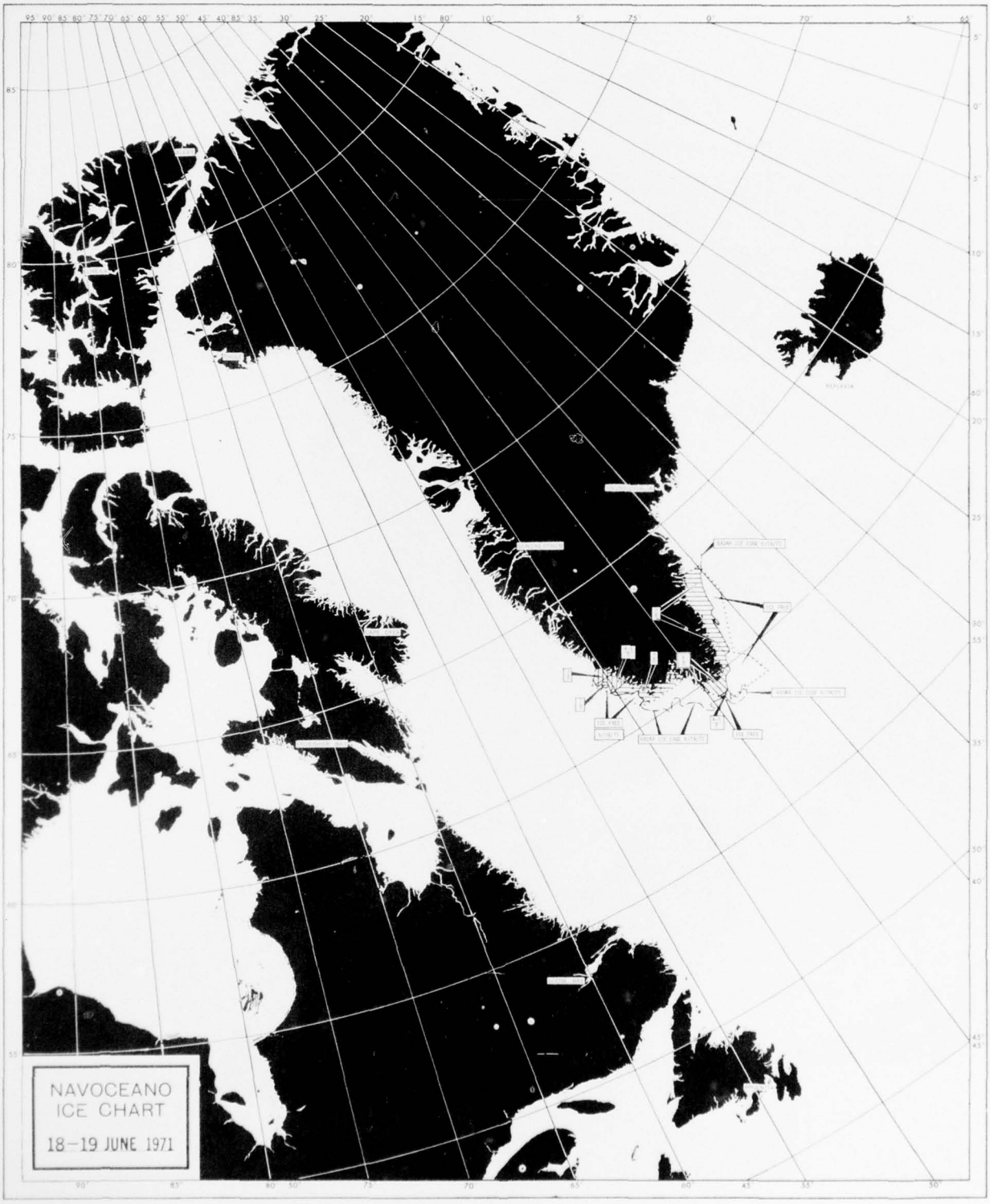
ICE CHART
14-18 JUNE 1971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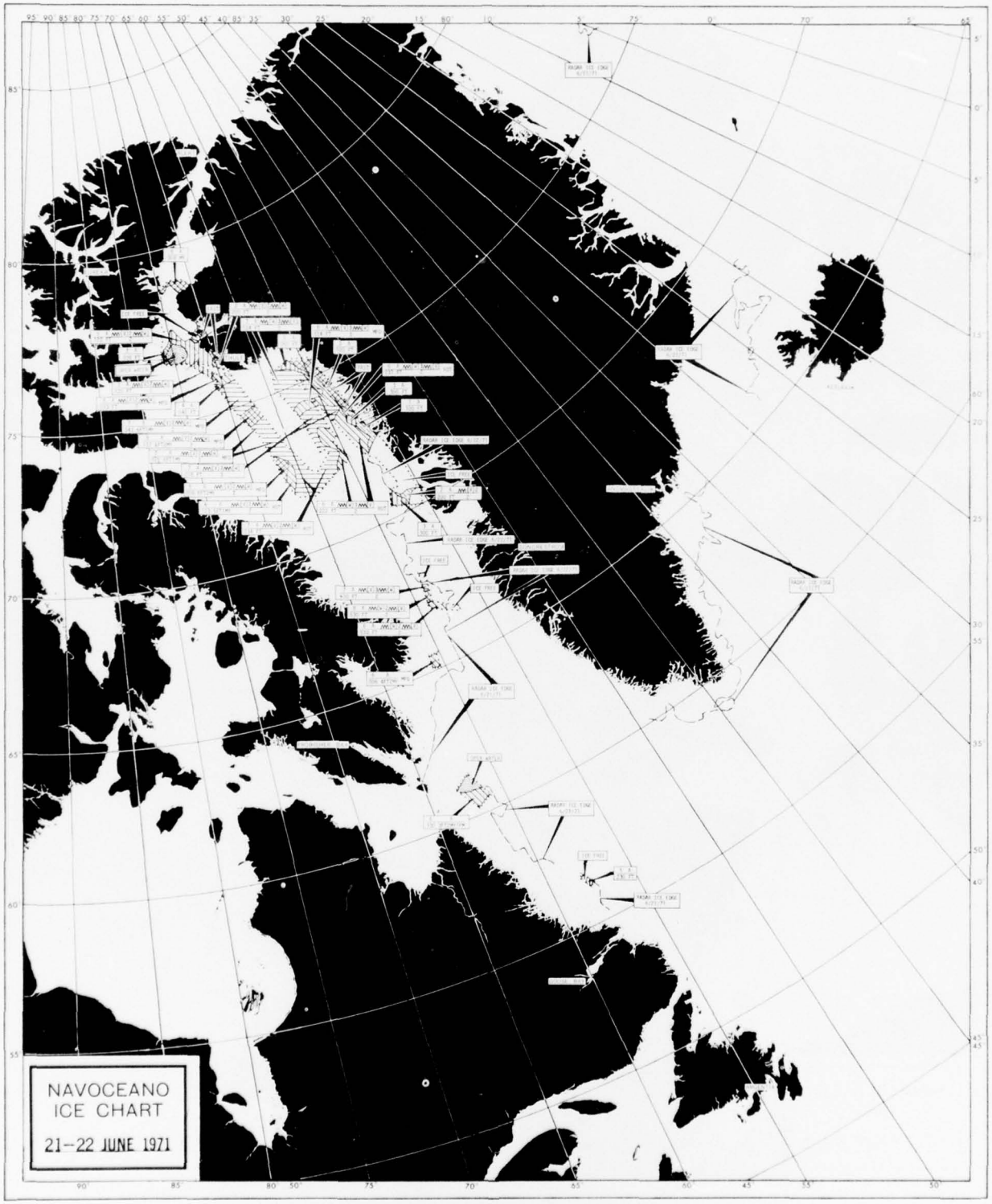
18–19 JUNE 1971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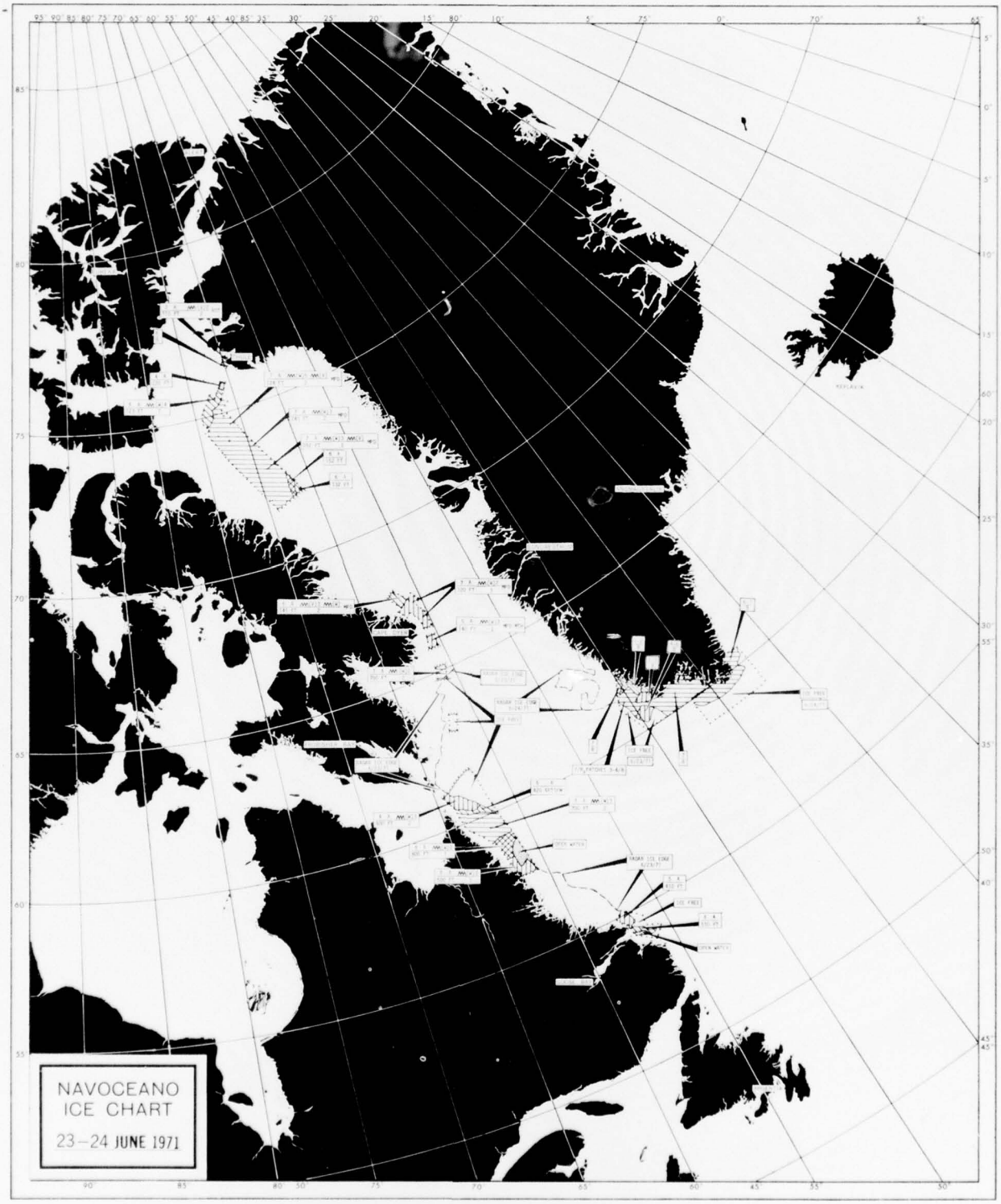
21–22 JUNE 1971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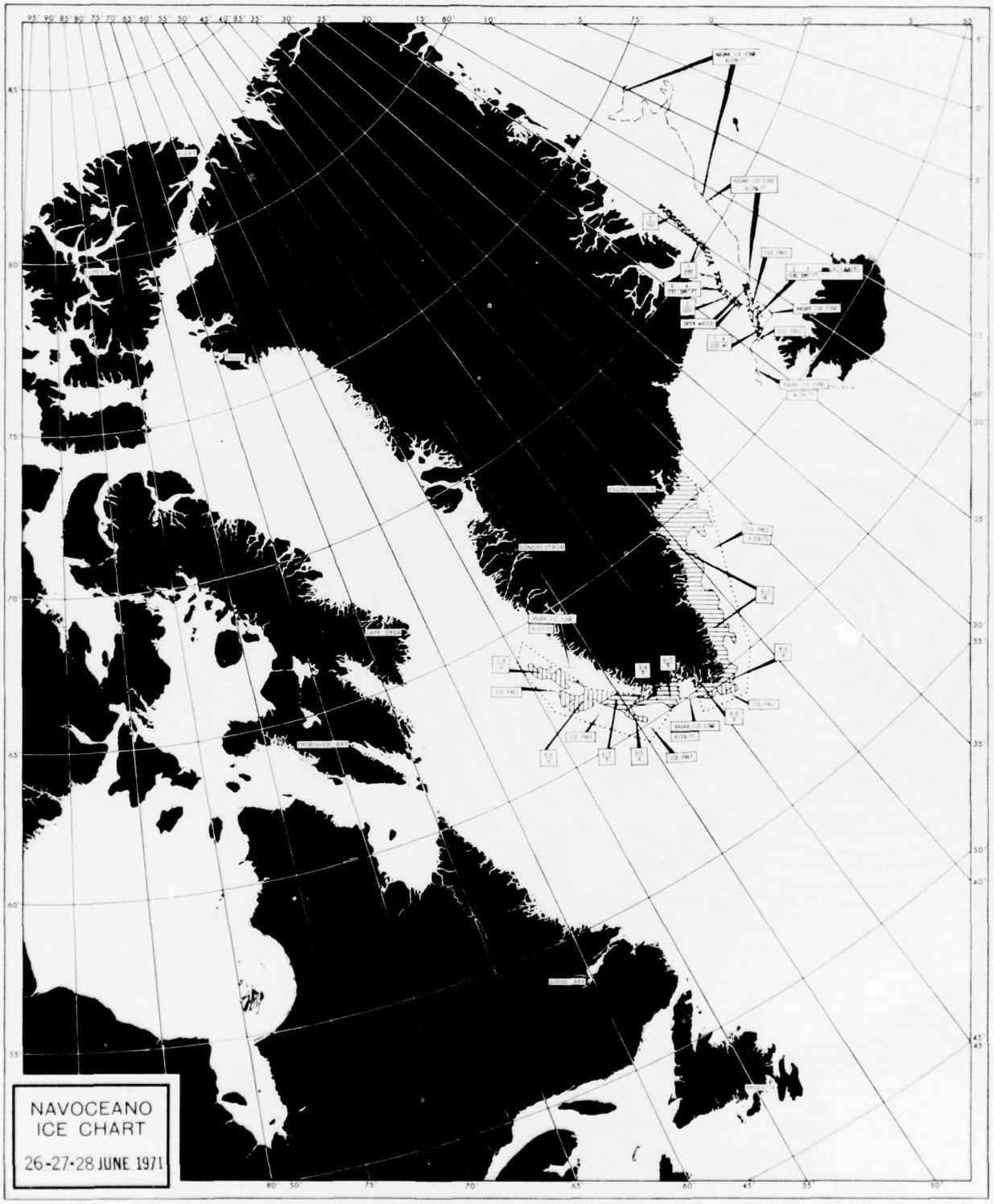
23–24 JUNE 1971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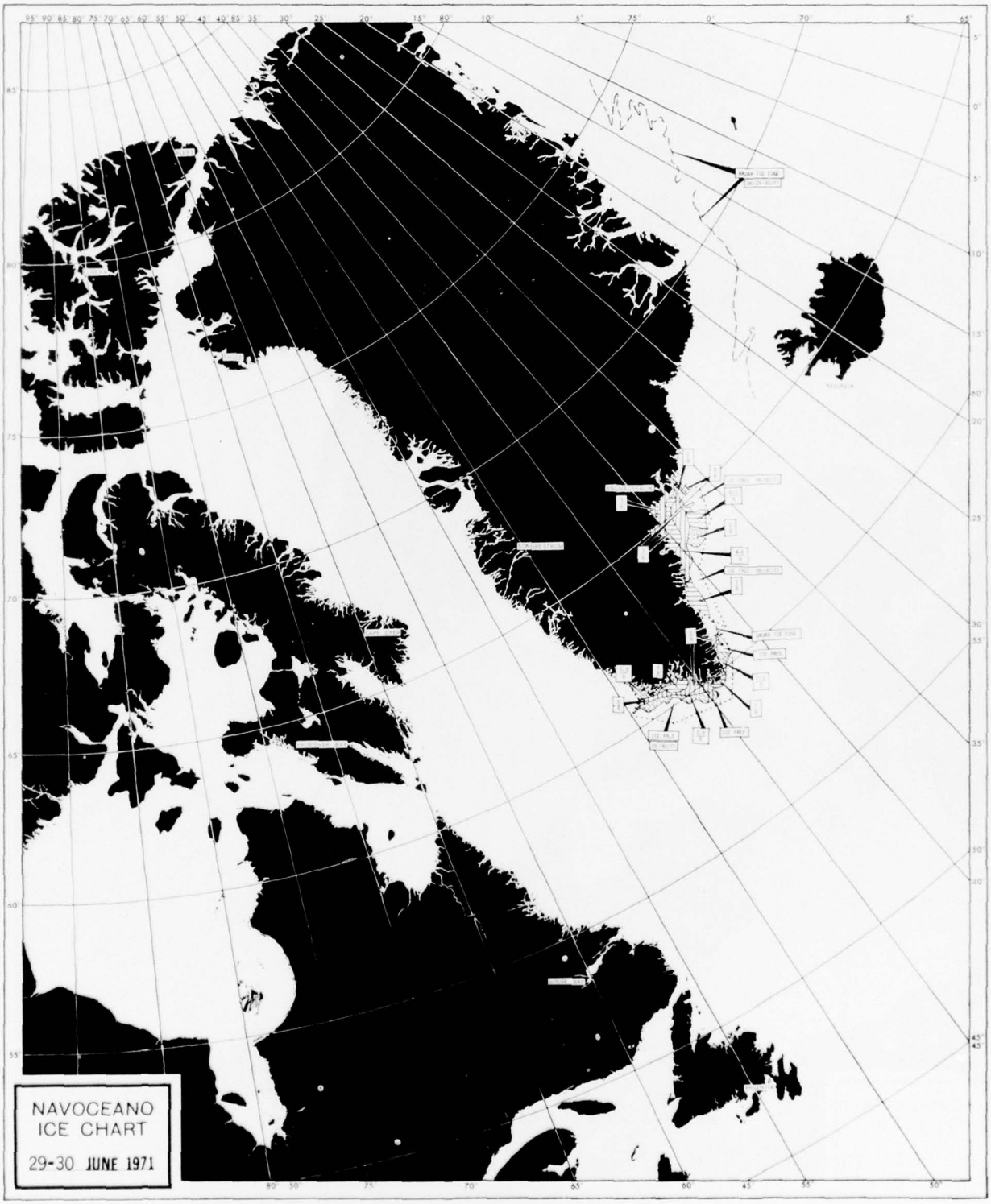
26-27-28 JUNE 1971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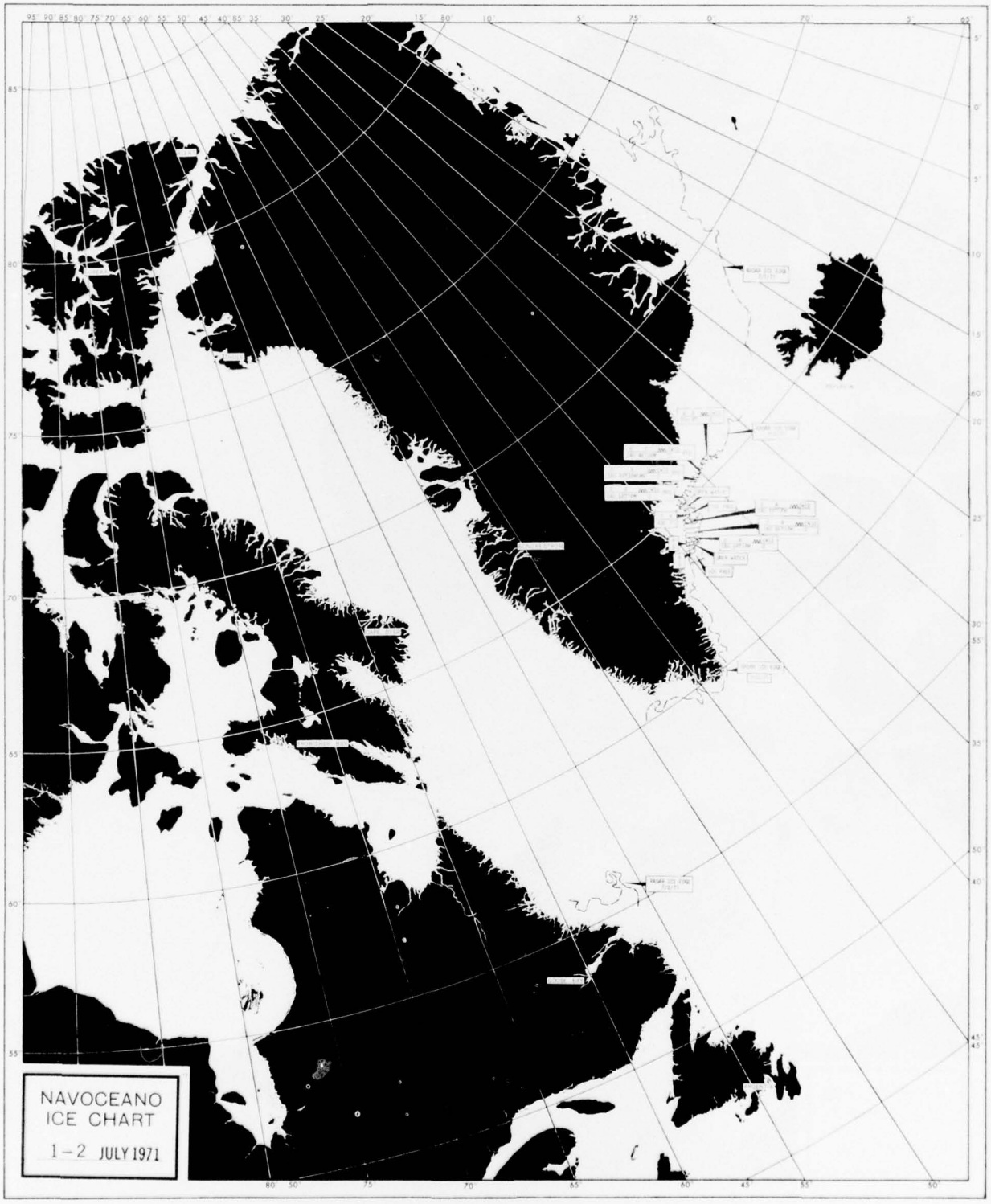
29-30 JUNE 1971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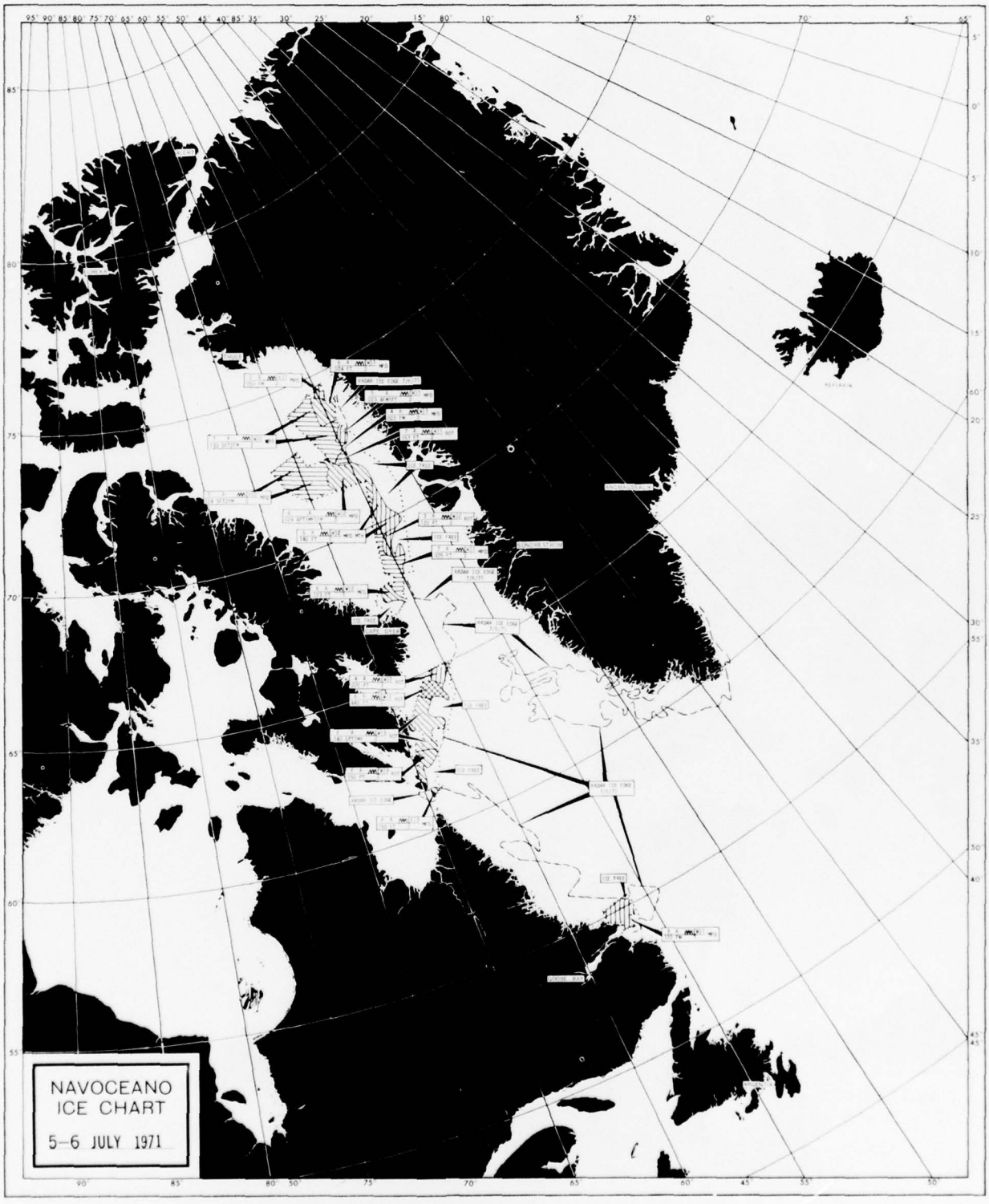
1 – 2 JULY 1971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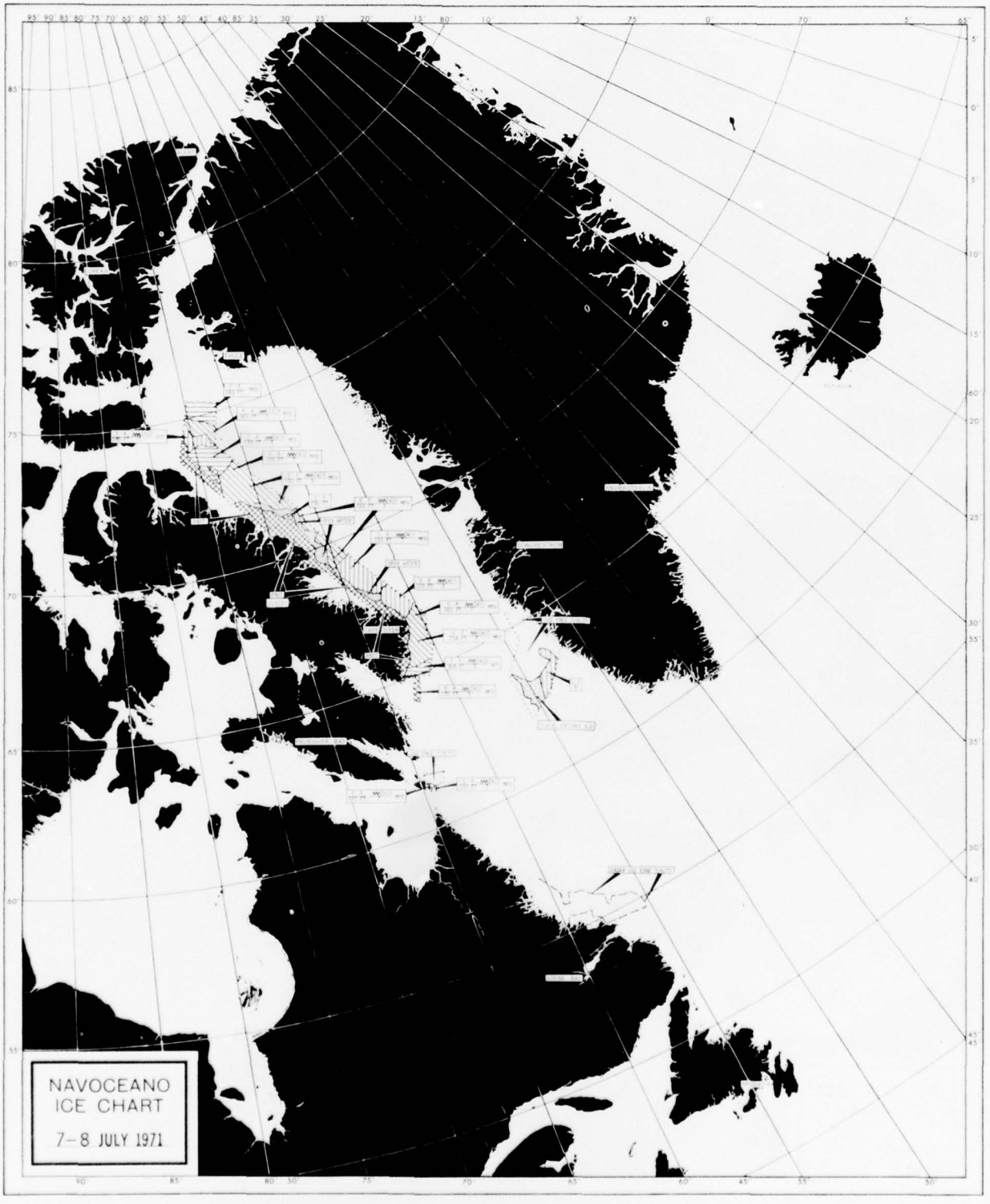
5–6 JULY 1971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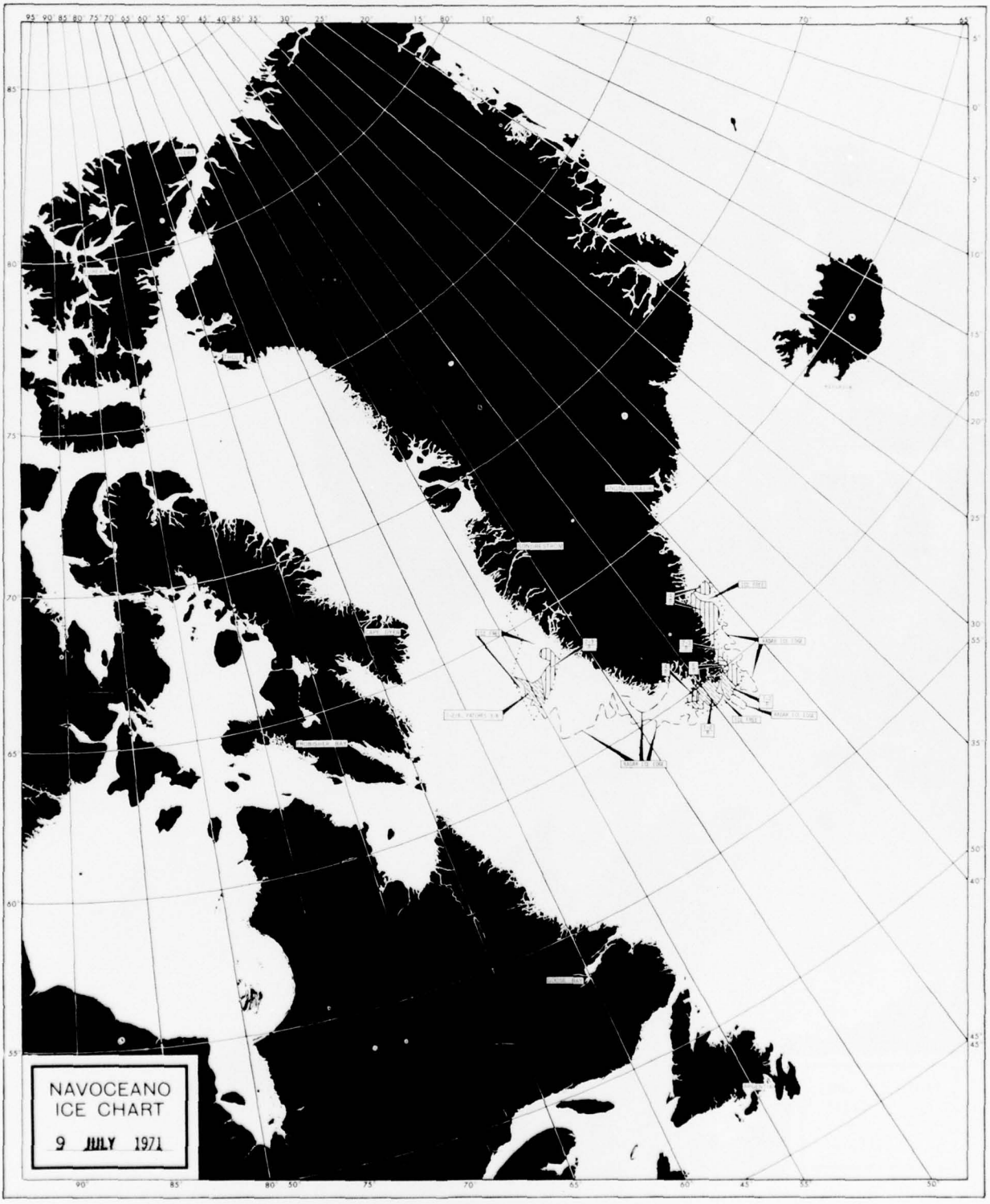
7–8 JULY 1971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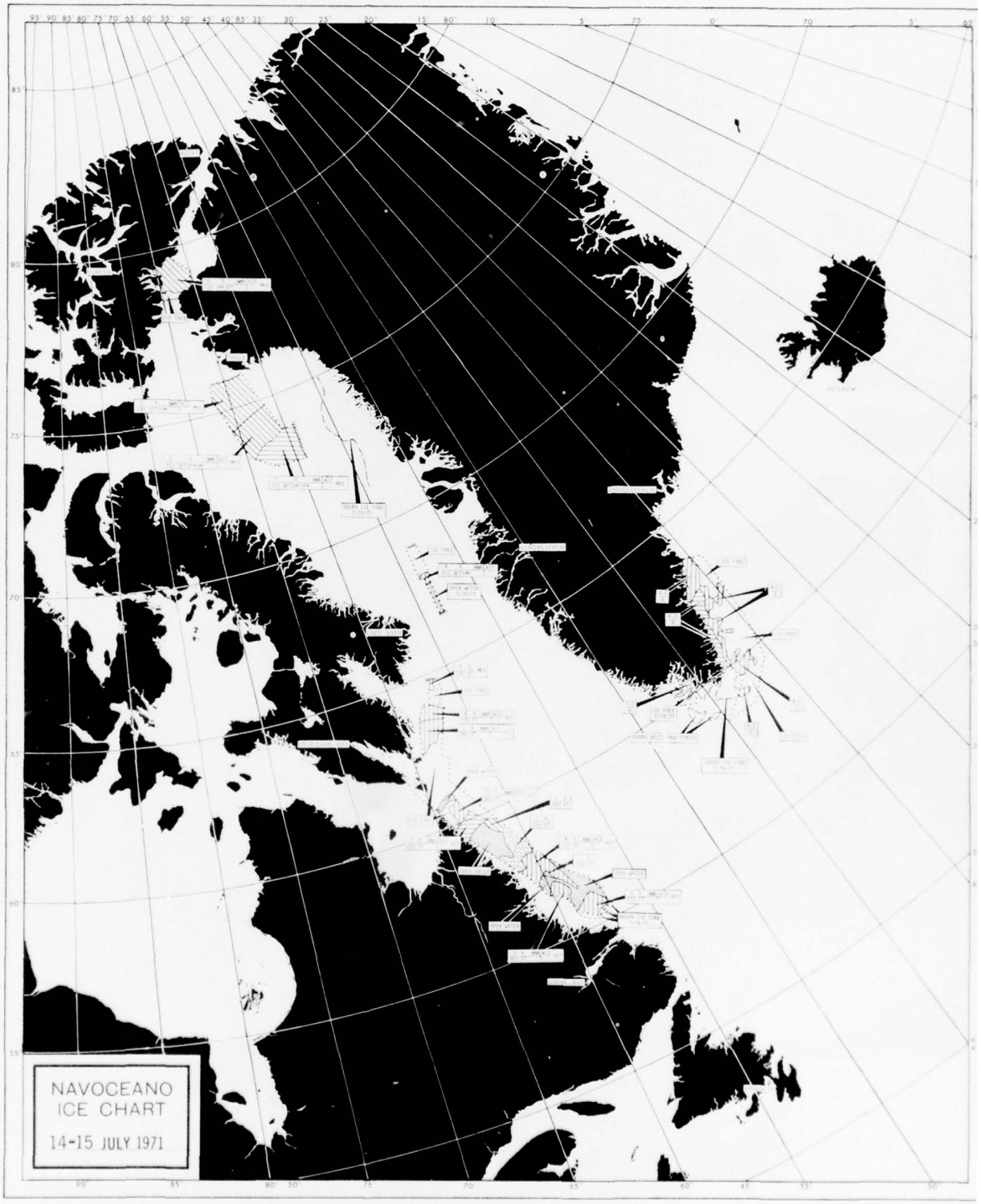
9 JULY 1971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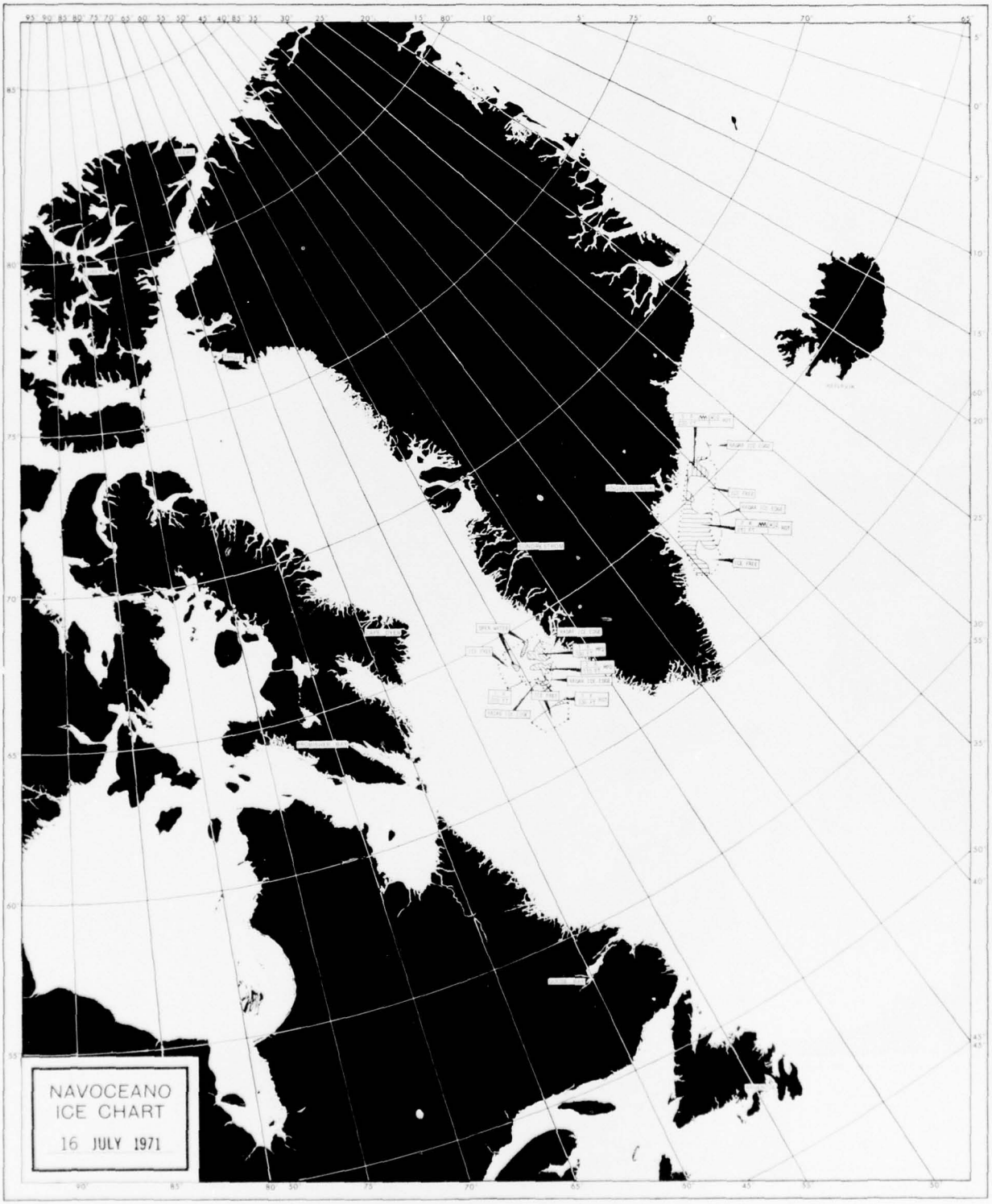
14-15 JULY 1971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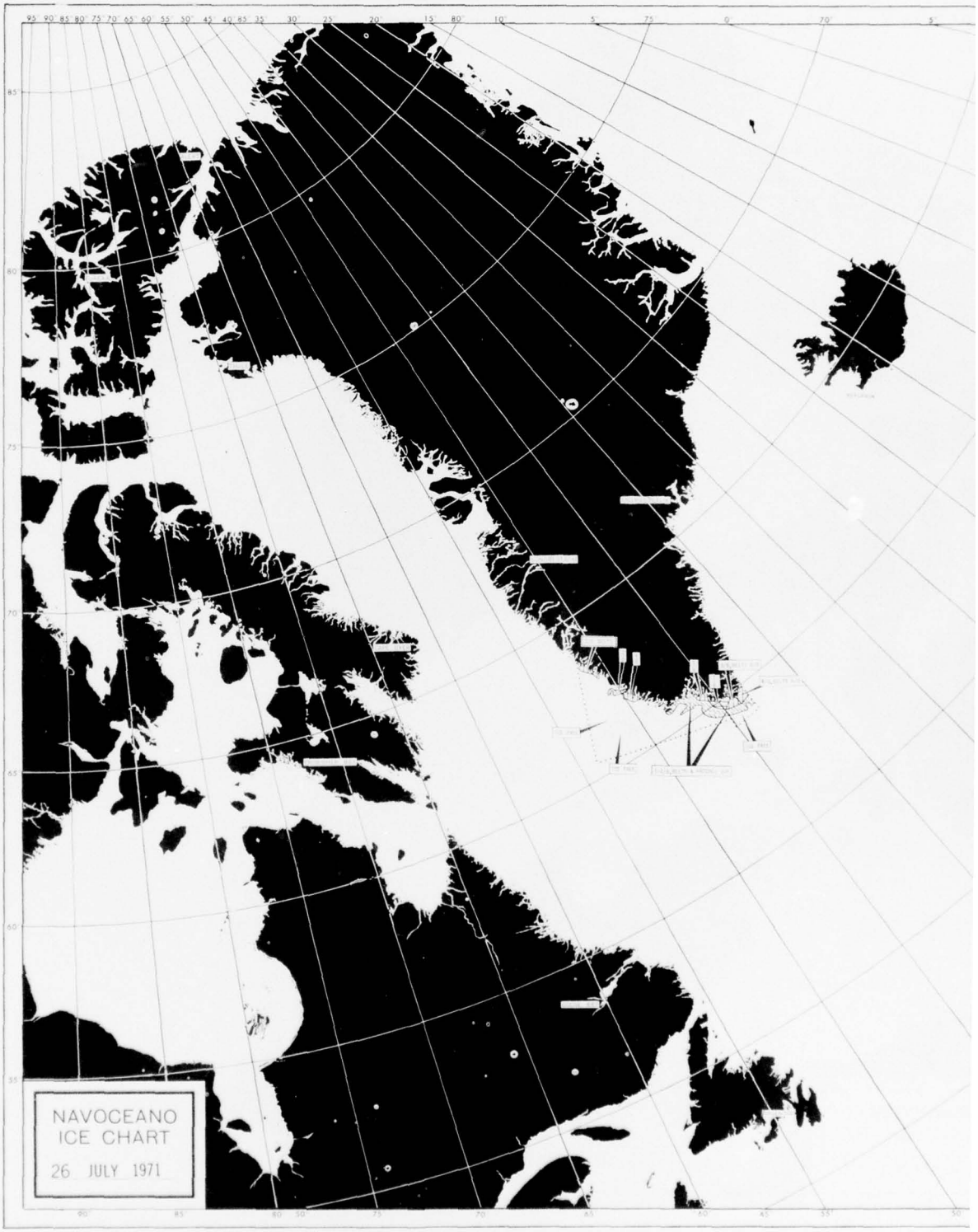
ICE CHART
16 JULY 1971


NAVOCEANO
ICE CHART
18–22 JULY 1971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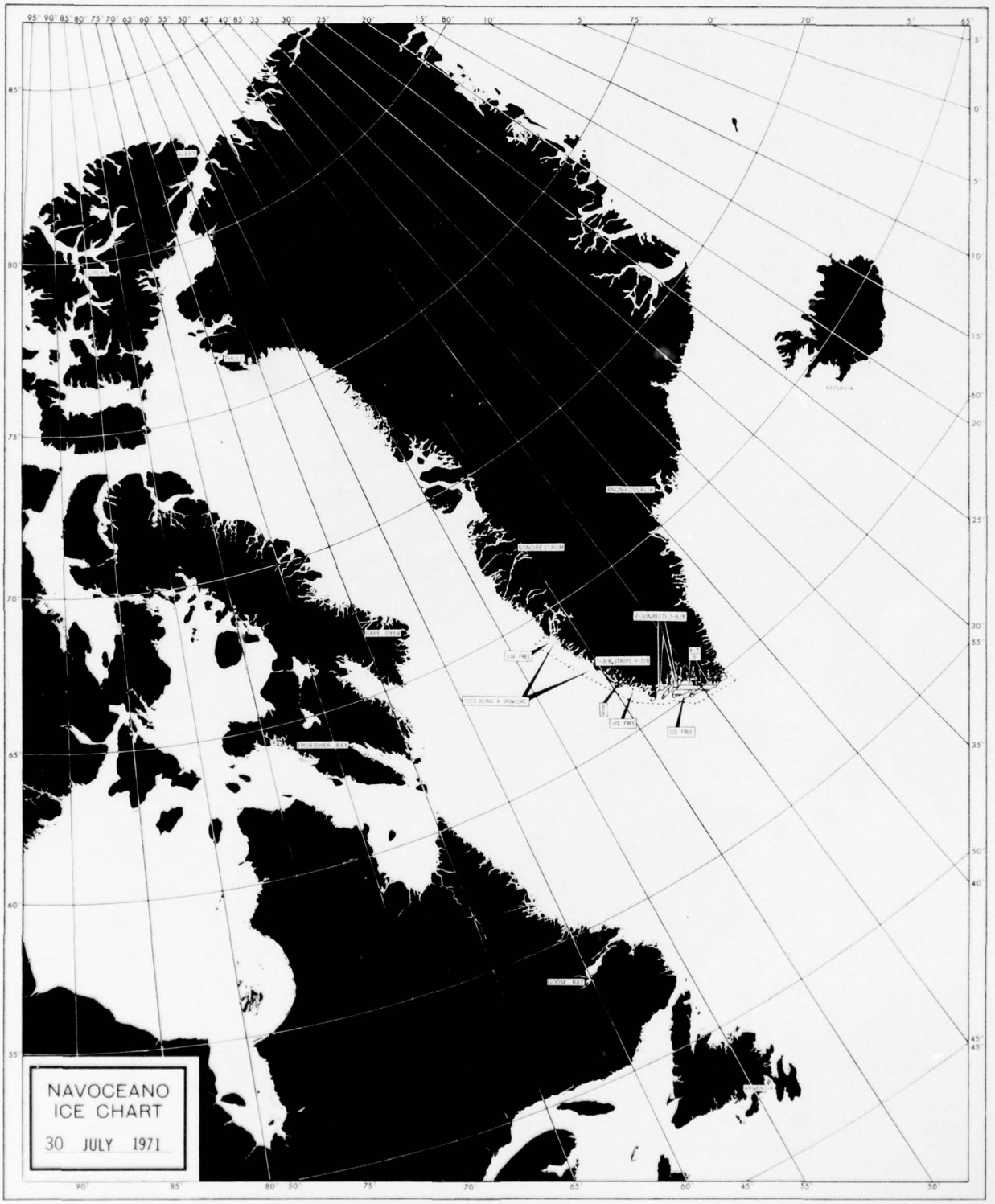
26 JULY 1971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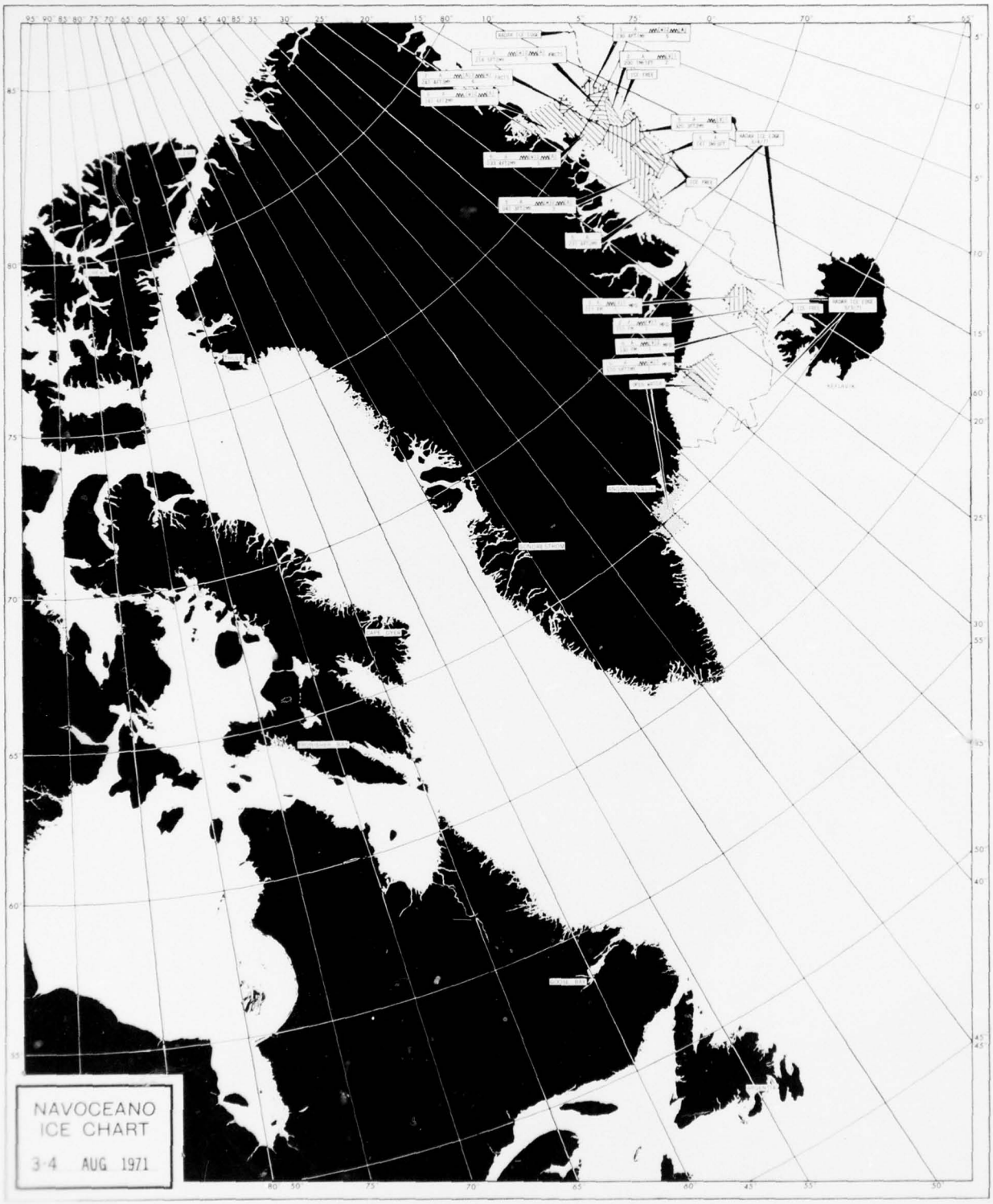
ICE CHART
30 JULY 1971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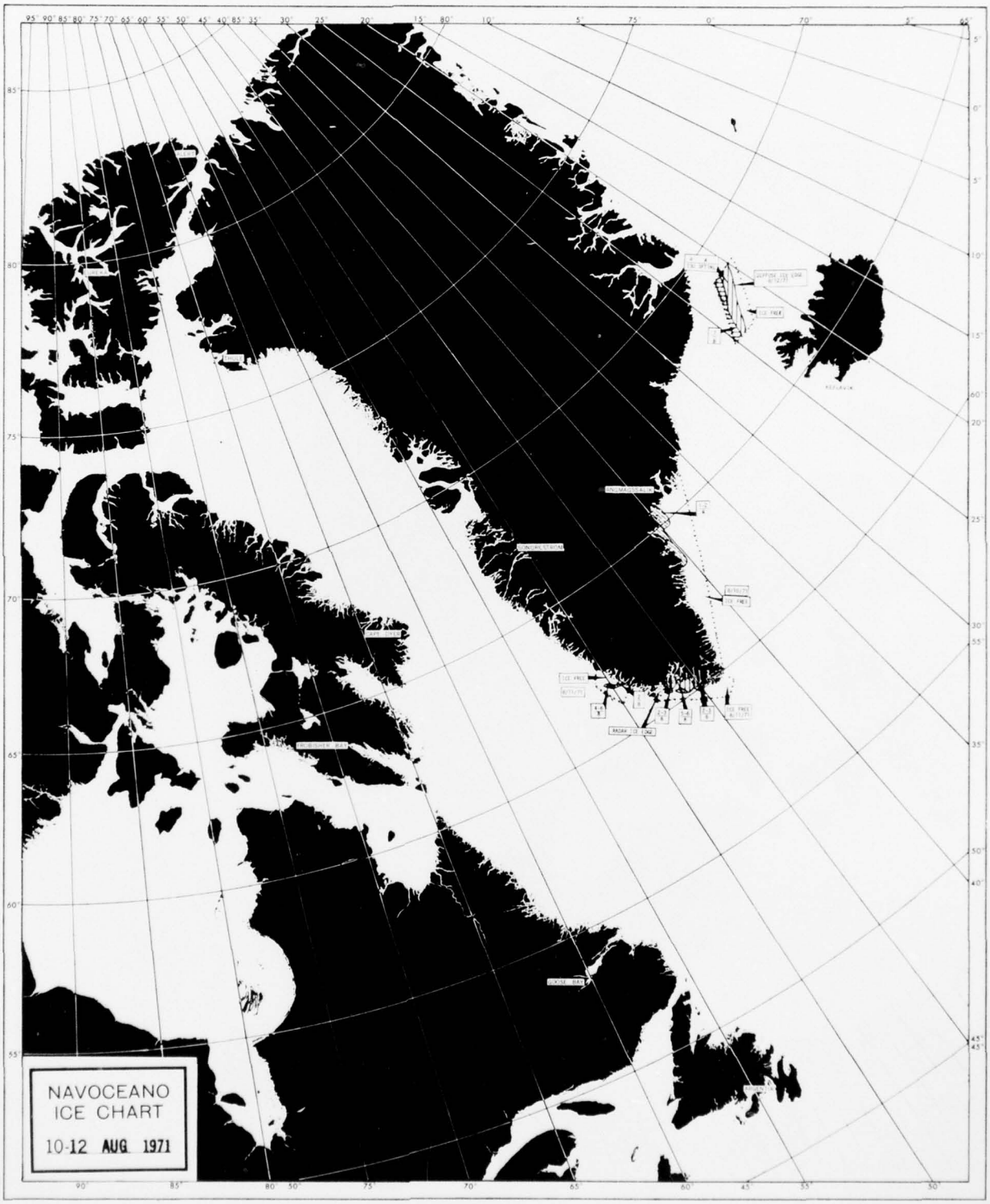
ICE CHART
3-4 AUG 1971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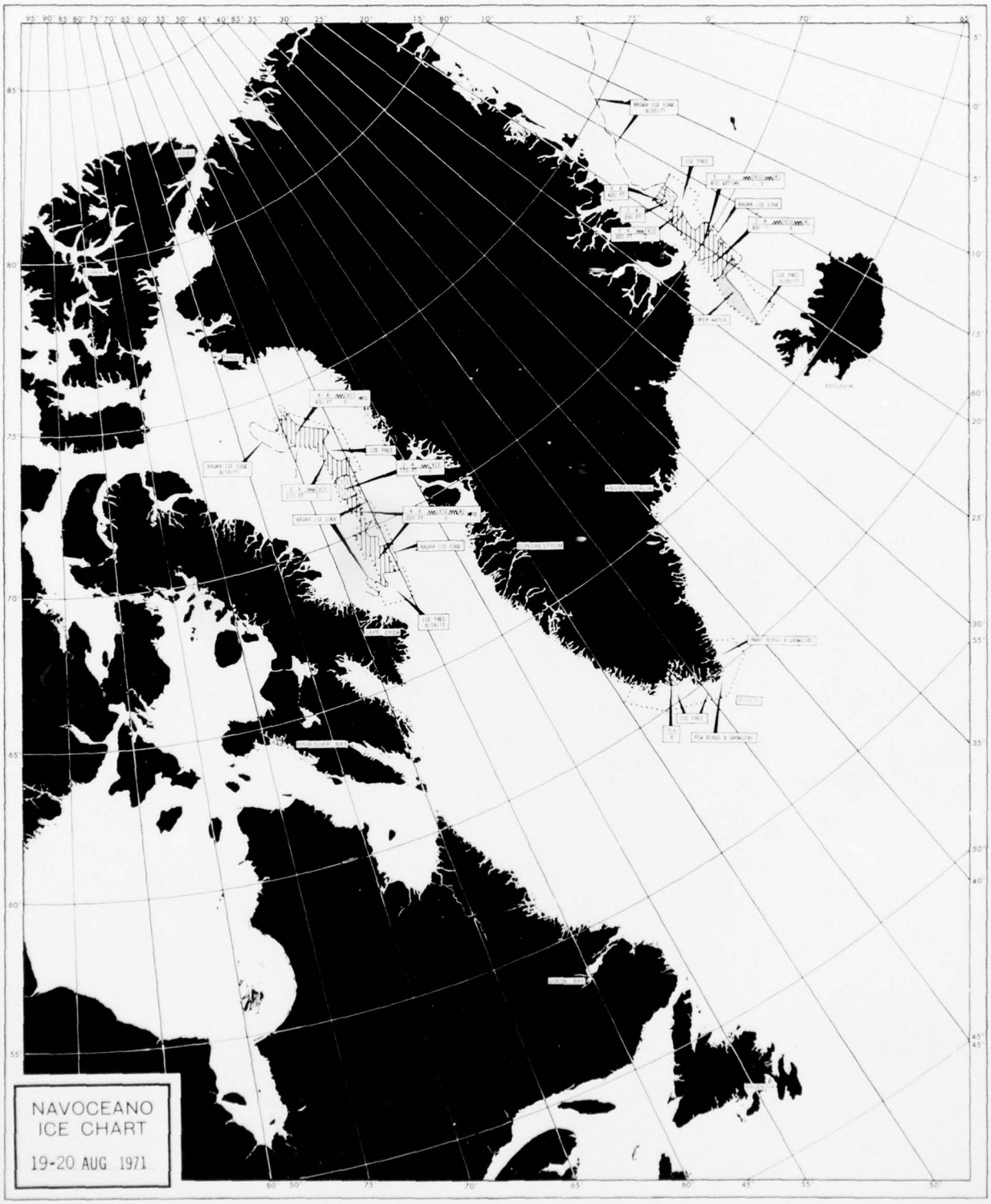
10-12 AUG 1971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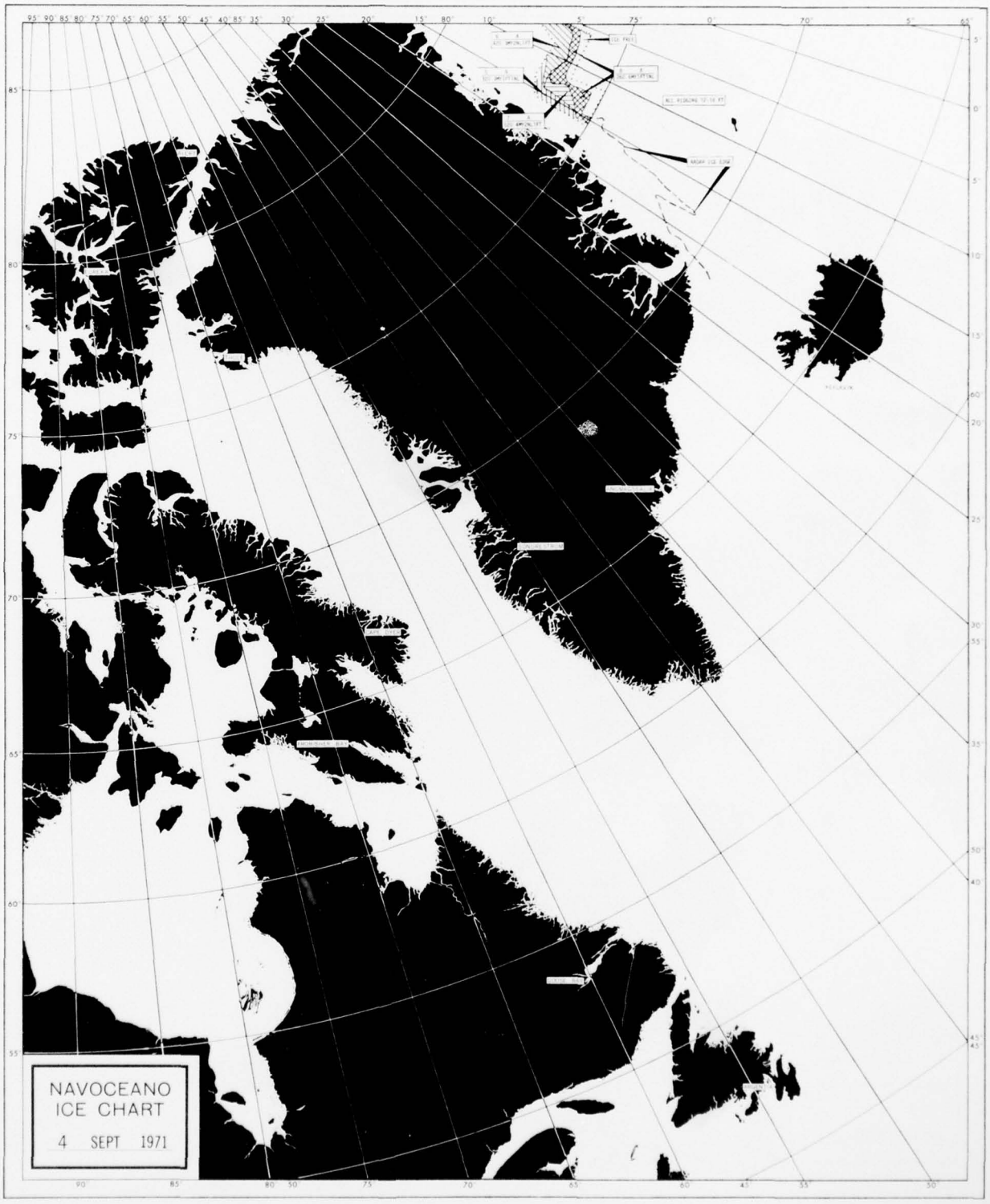
19-20 AUG 1971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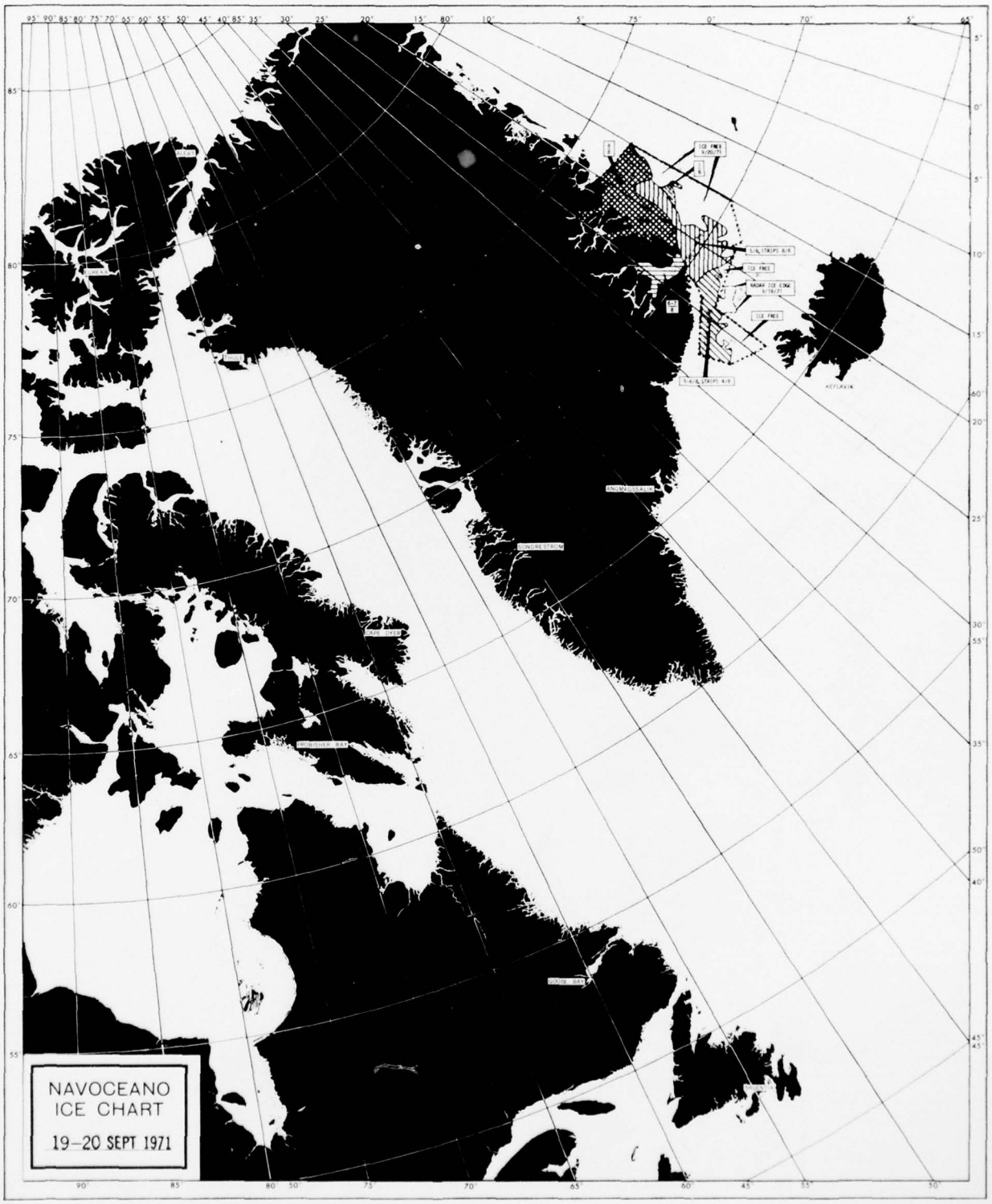
4 SEPT 1971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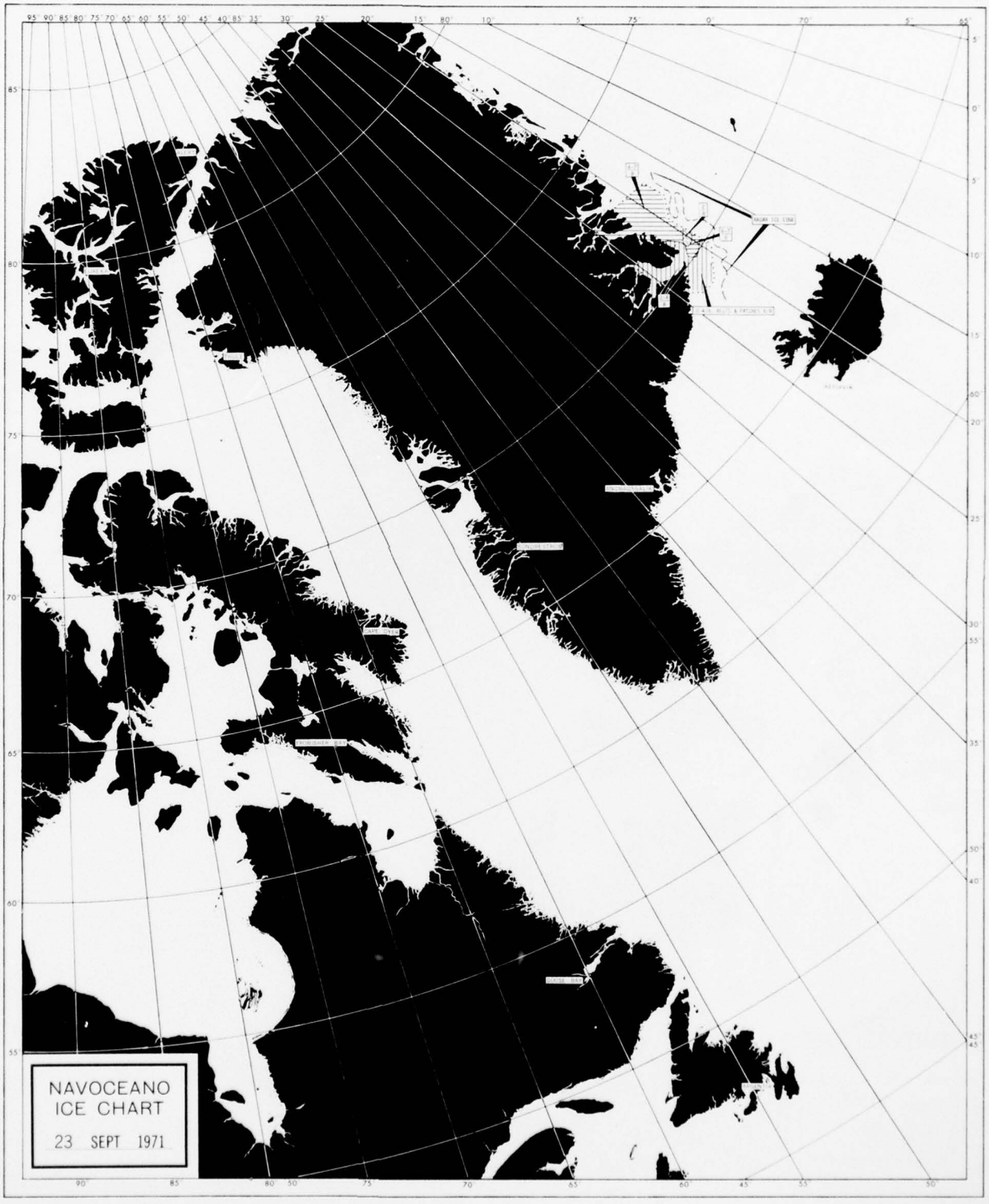
ICE CHART
19–20 SEPT 1971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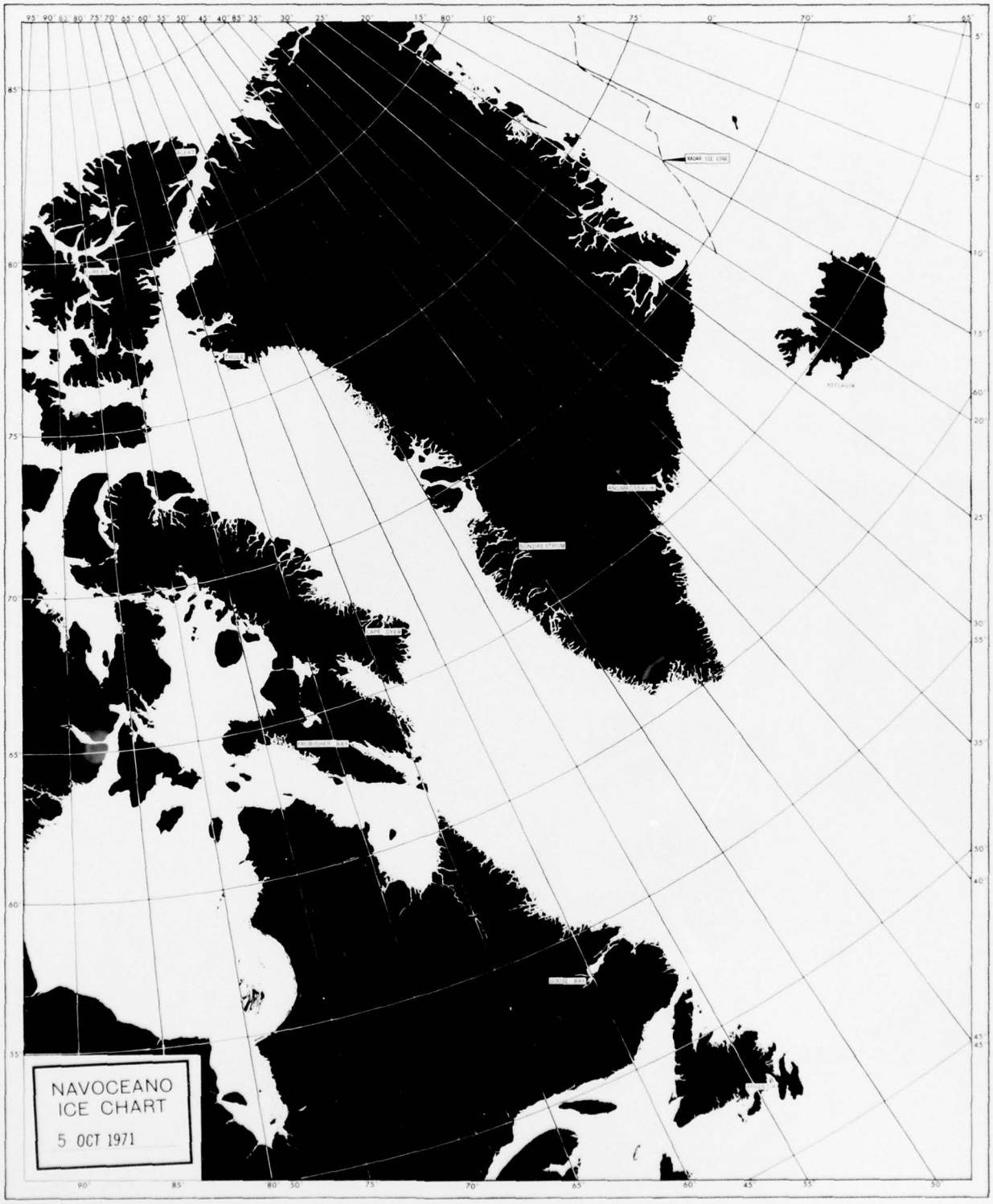
ICE CHART
23 SEPT 1971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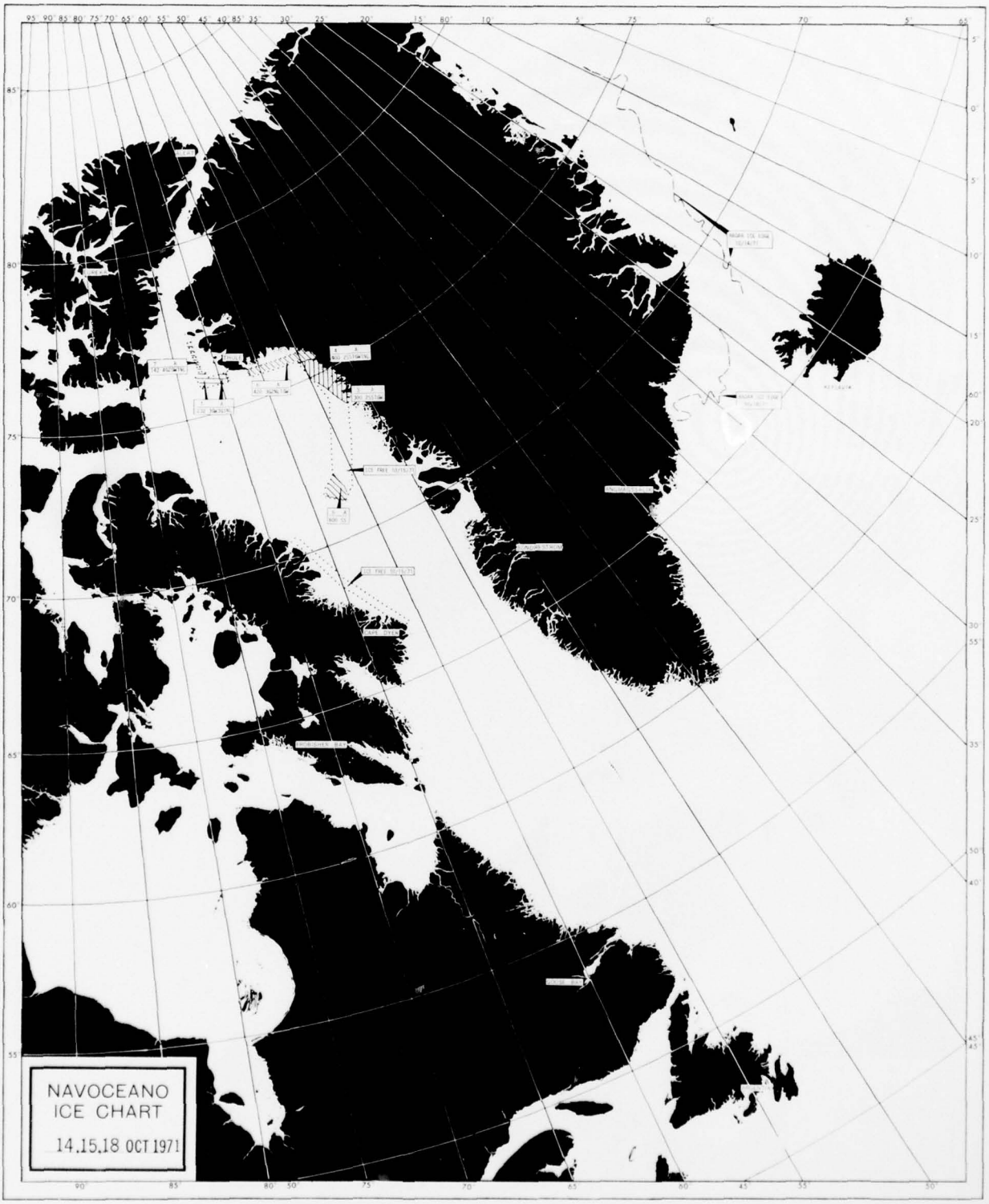
ICE CHART
5 OCT 1971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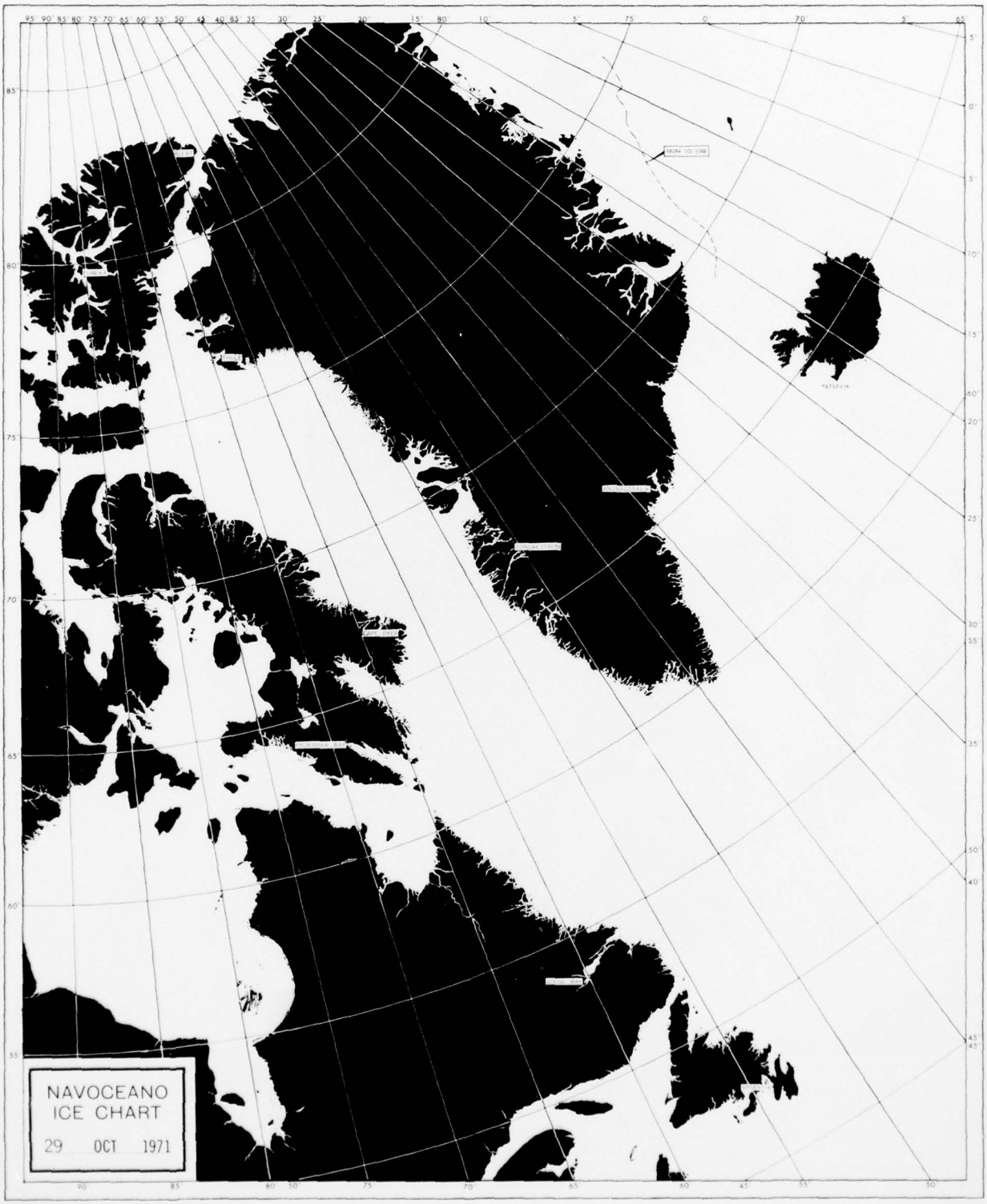
ICE CHART
14.15.18 OCT 1971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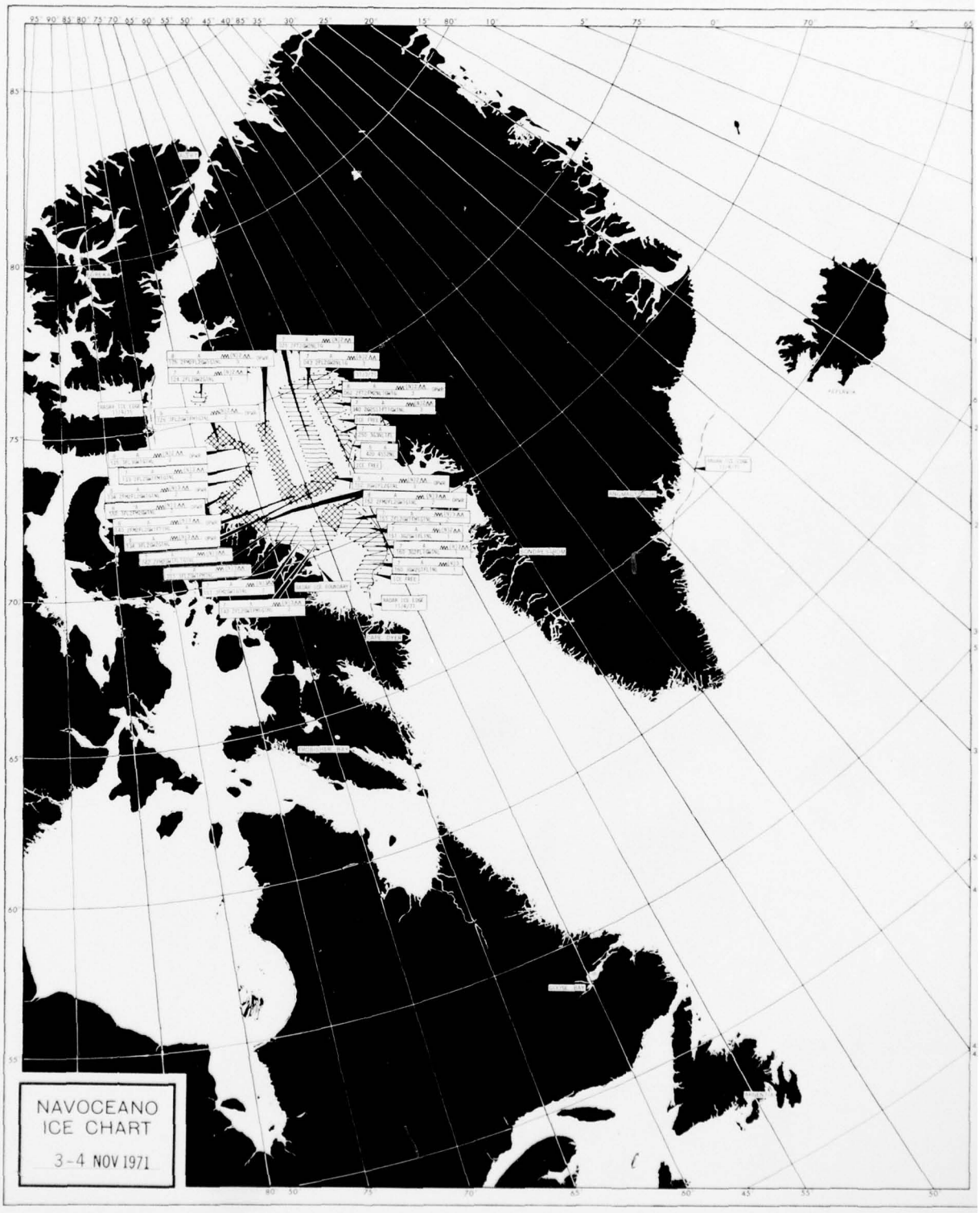
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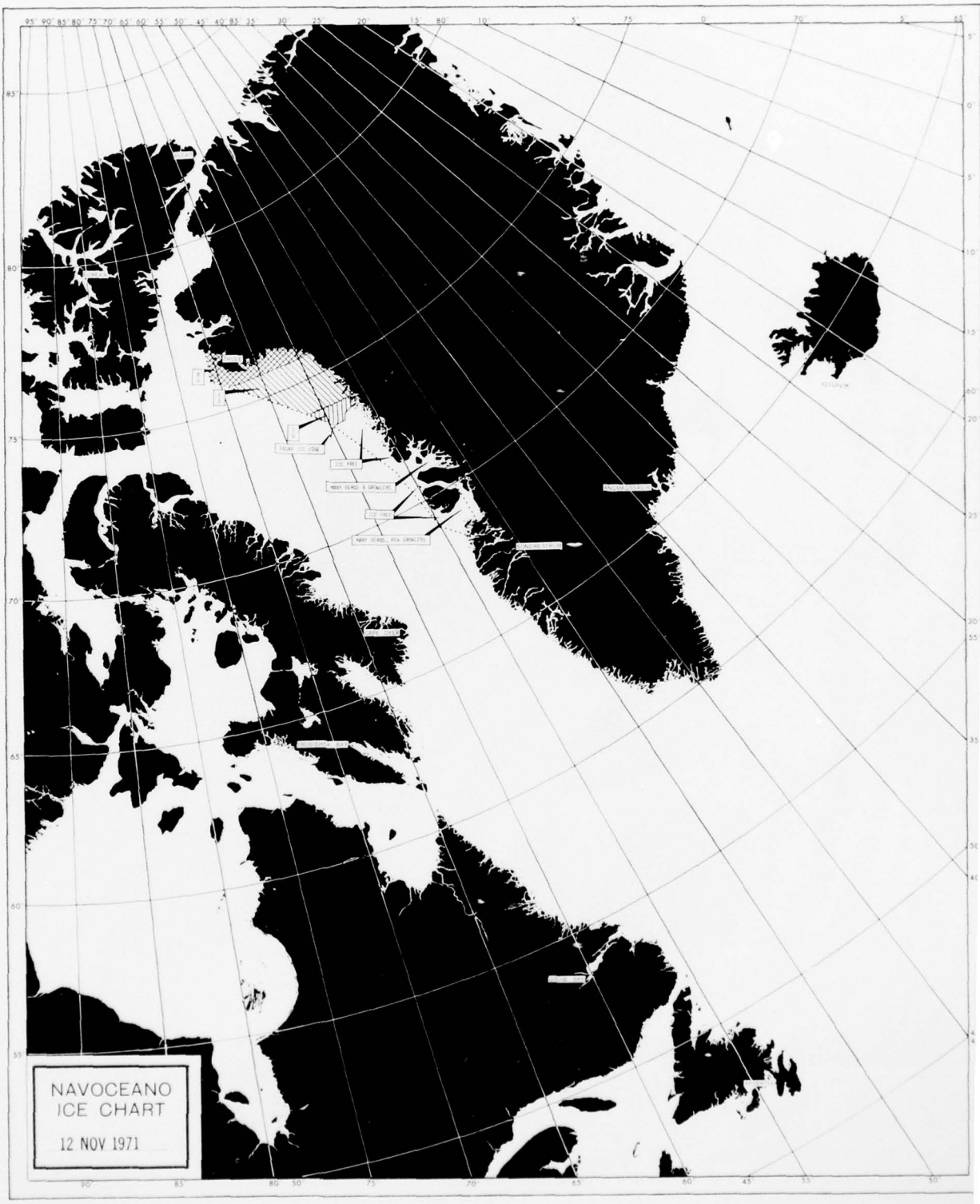
3-4 NOV 1971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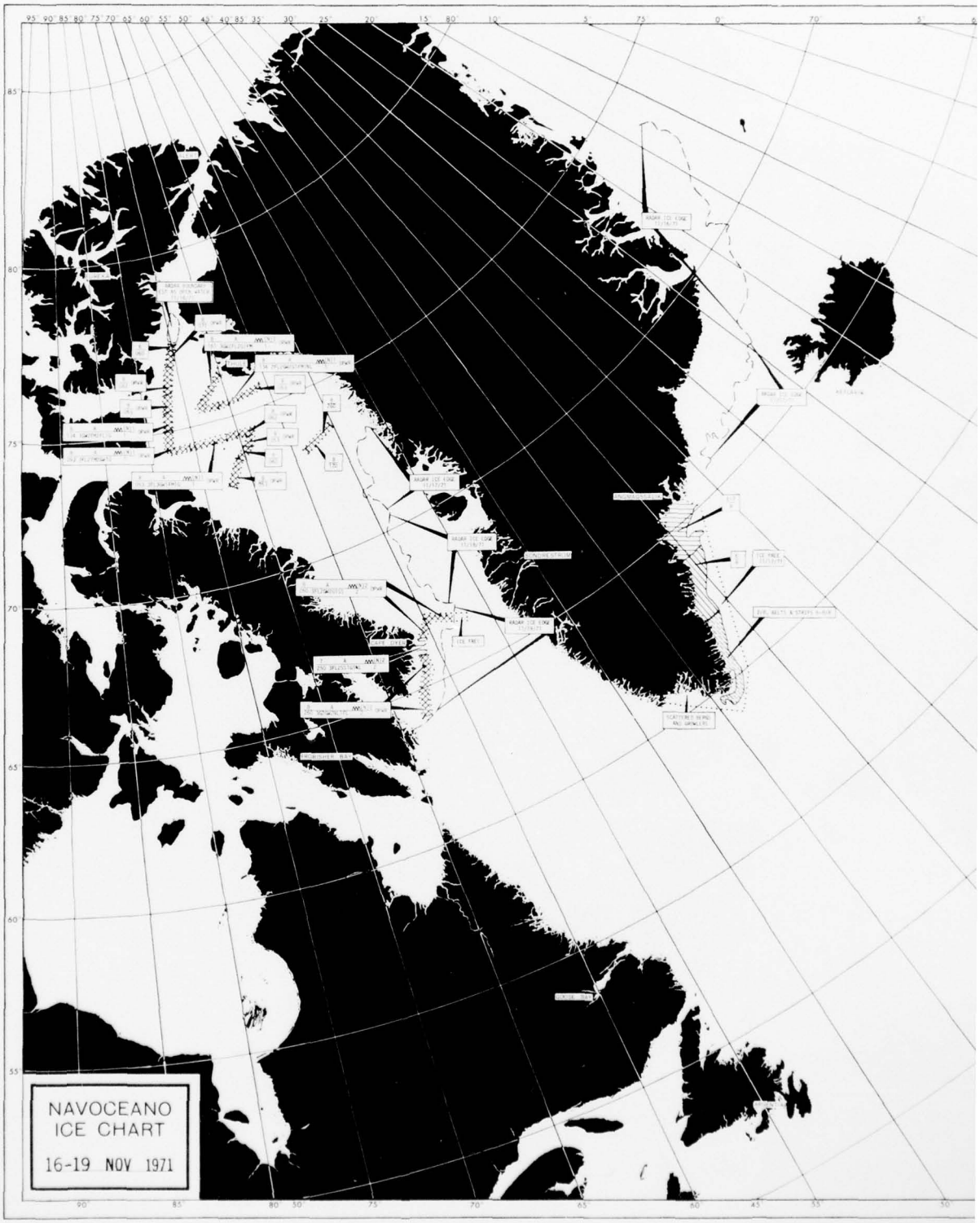
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ICE CHART
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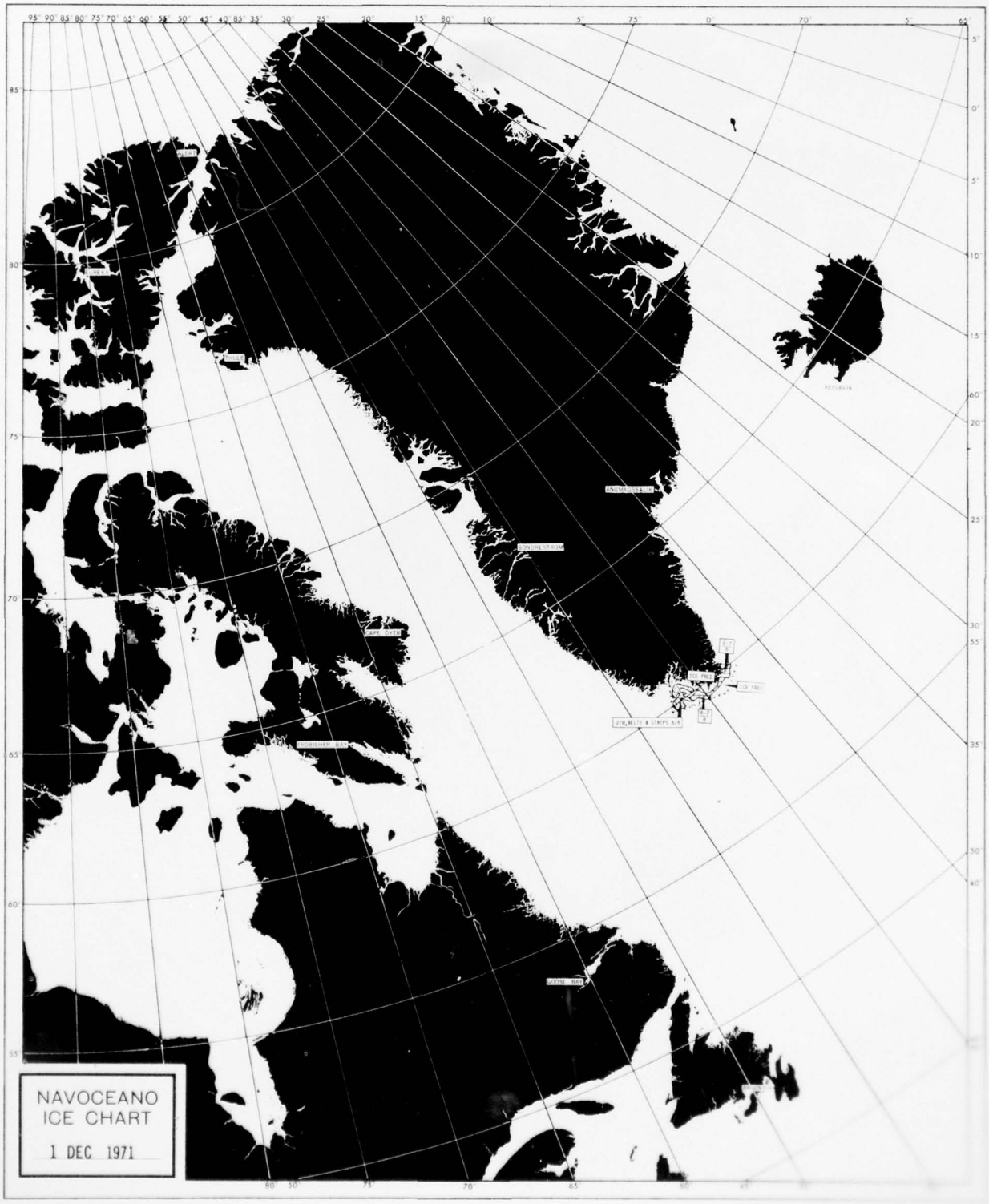
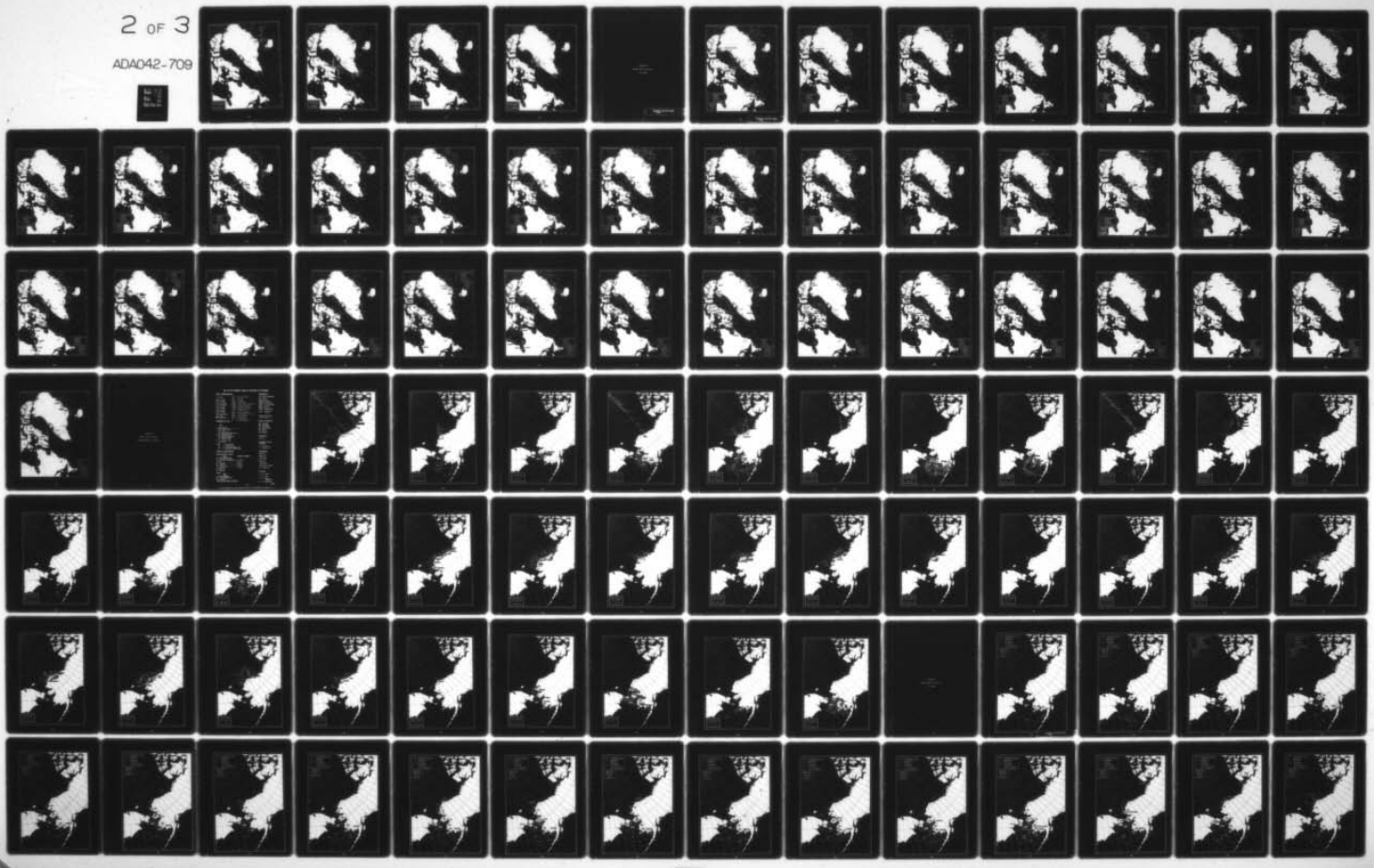
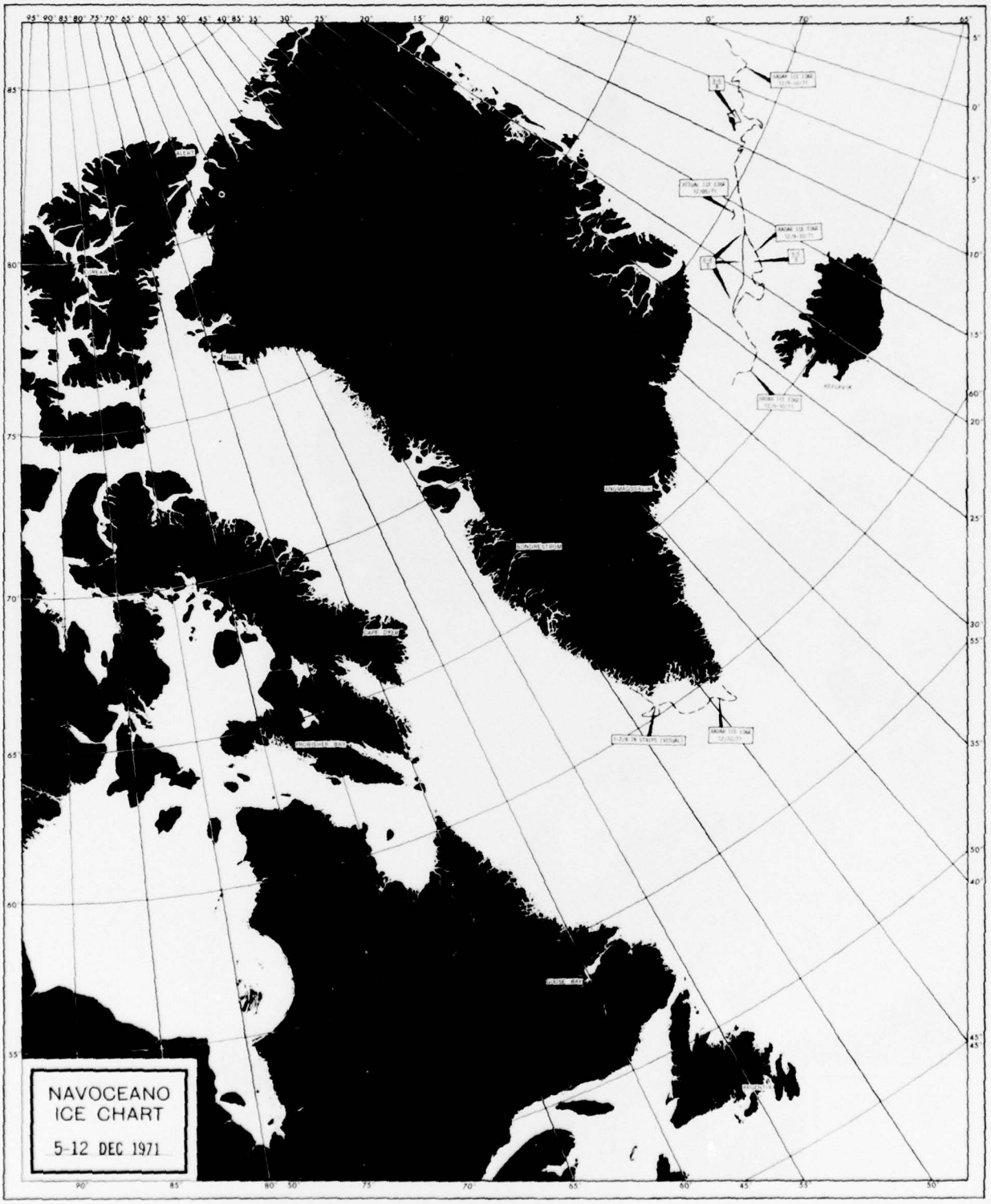

NAVOCEANO
ICE CHART
1 DEC 1971

AD-A042 709 NAVAL OCEANOGRAPHIC OFFICE WASHINGTON D C F/G 8/12
REPORT OF THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM-1971--ETC(U)
MAY 74 P A MITCHELL
UNCLASSIFIED NOO-SP-70(71) NL

2 OF 3
ADA042-709

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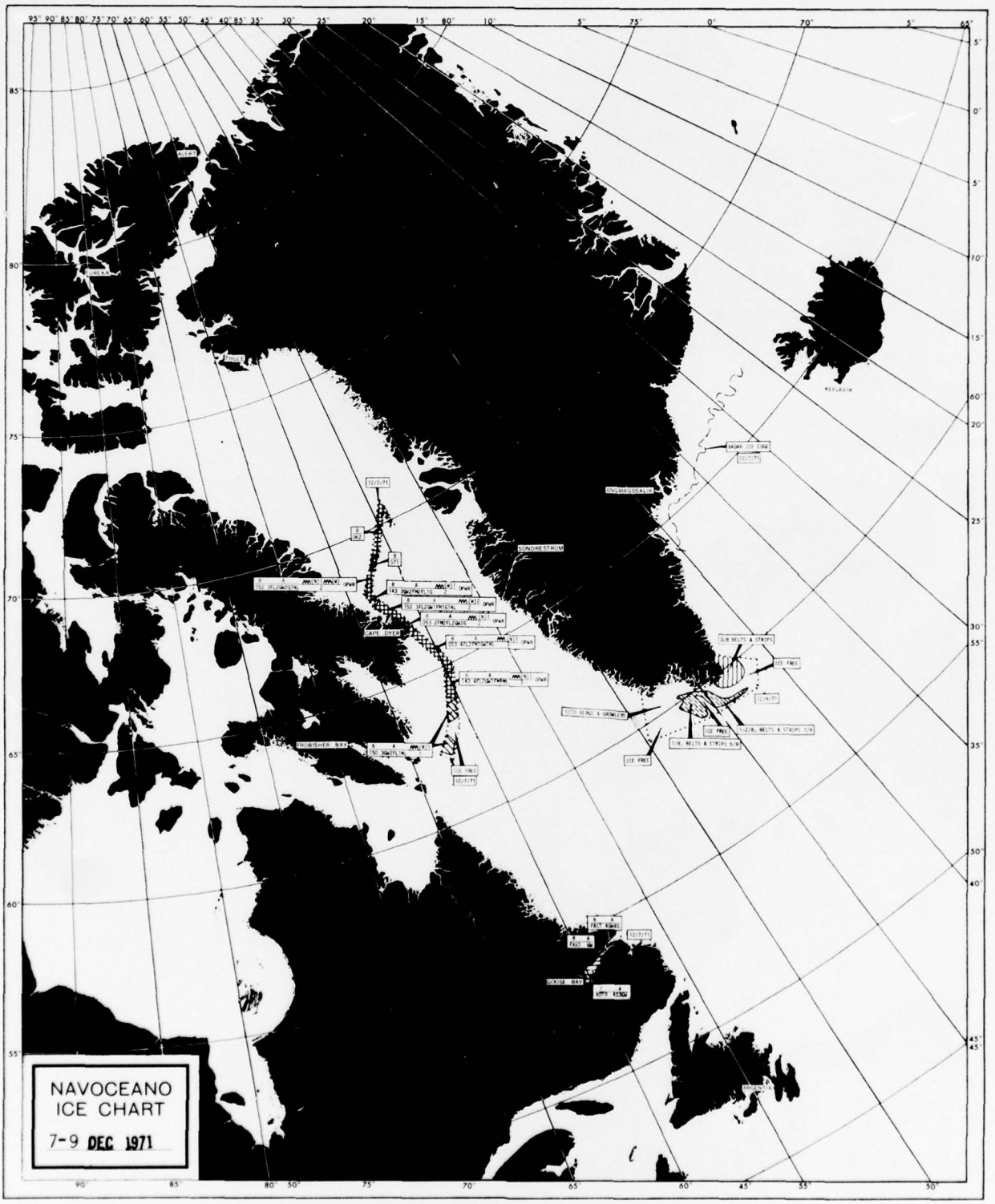
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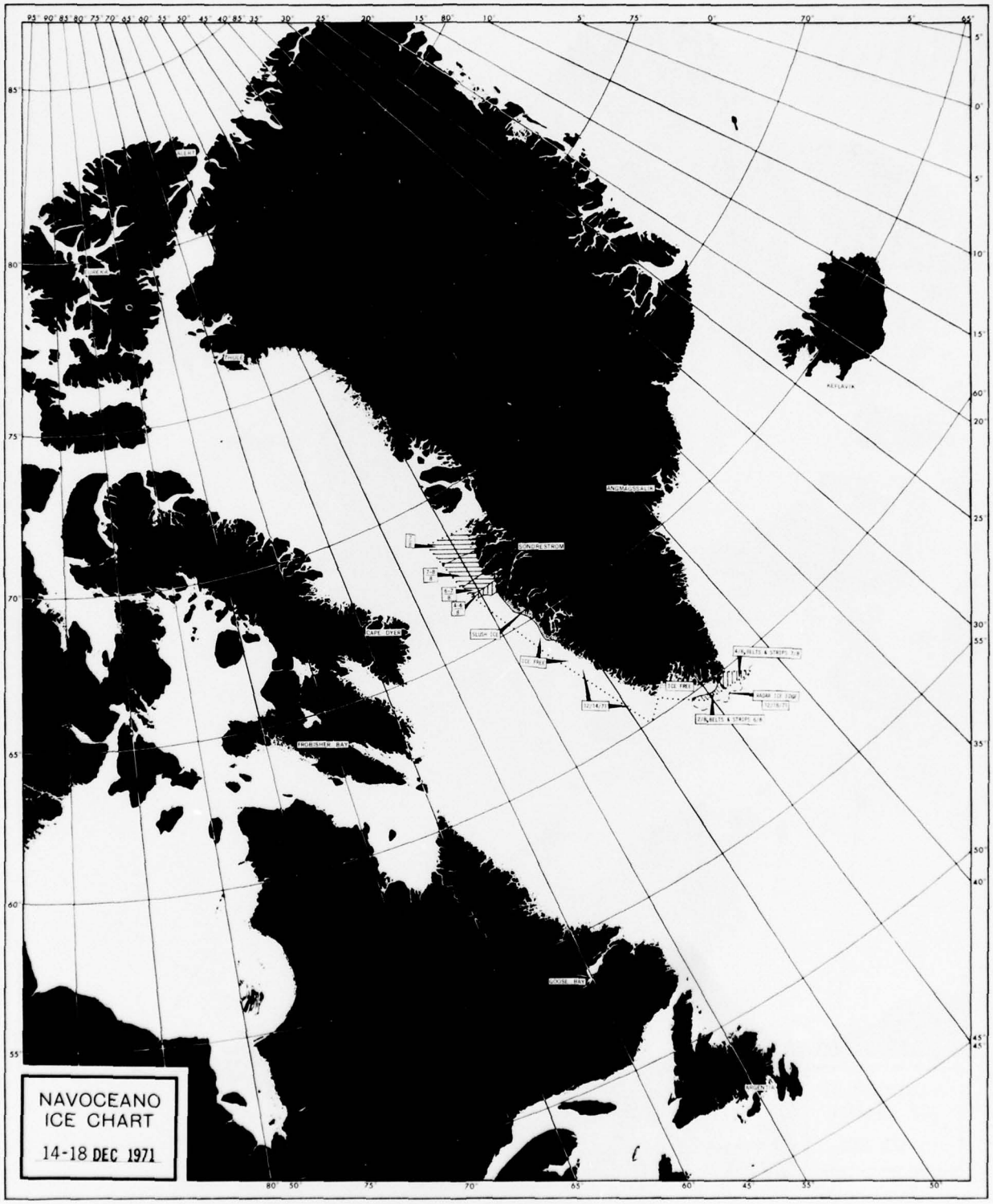
ICE CHART
7-9 DEC 1971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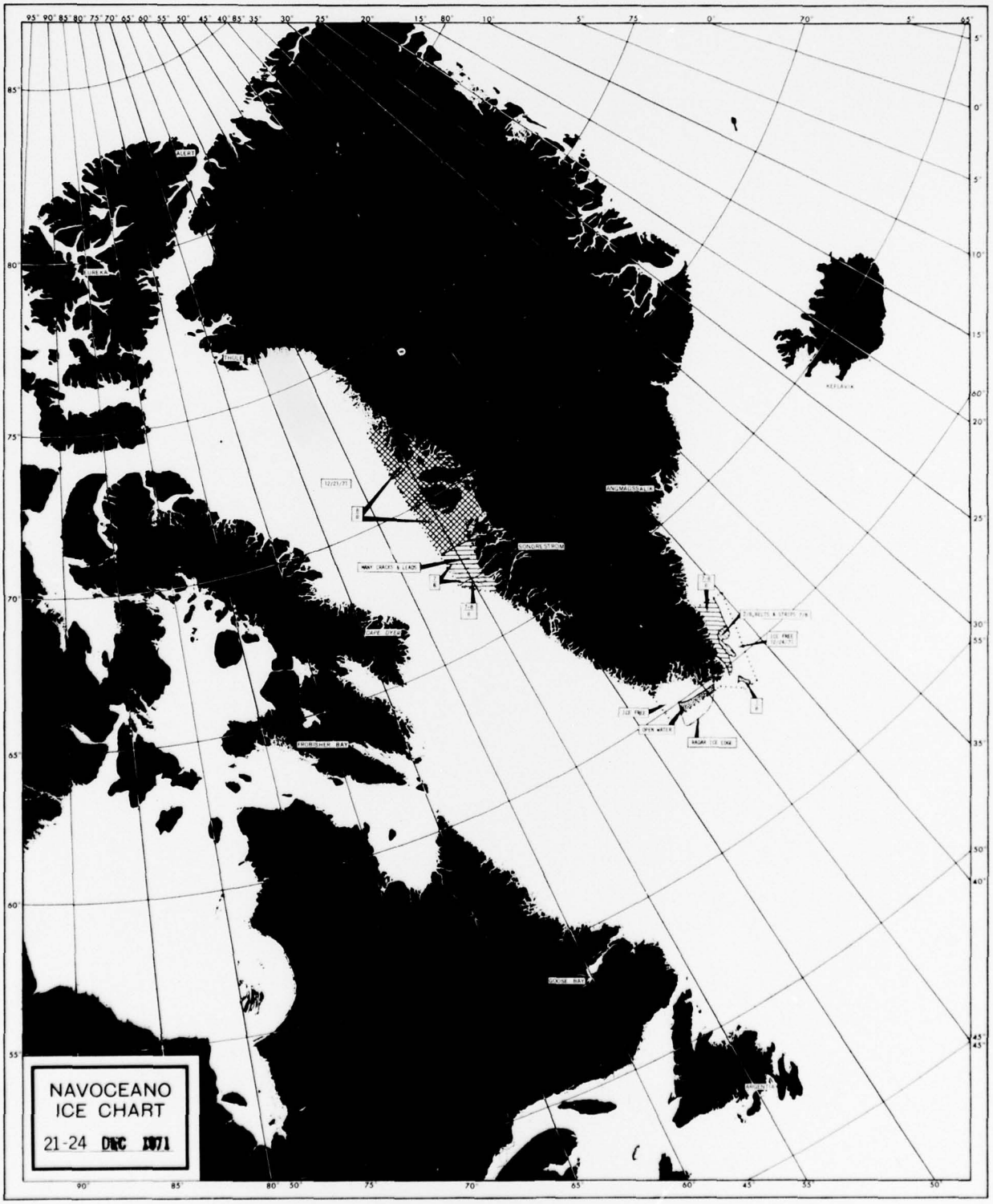
ICE CHART
14-18 DEC 1971
KEFLAVIK
ANGMASSALIK
SCORESTHOM
CAPE DYER
FROBISHER BAY
GOOSE BAY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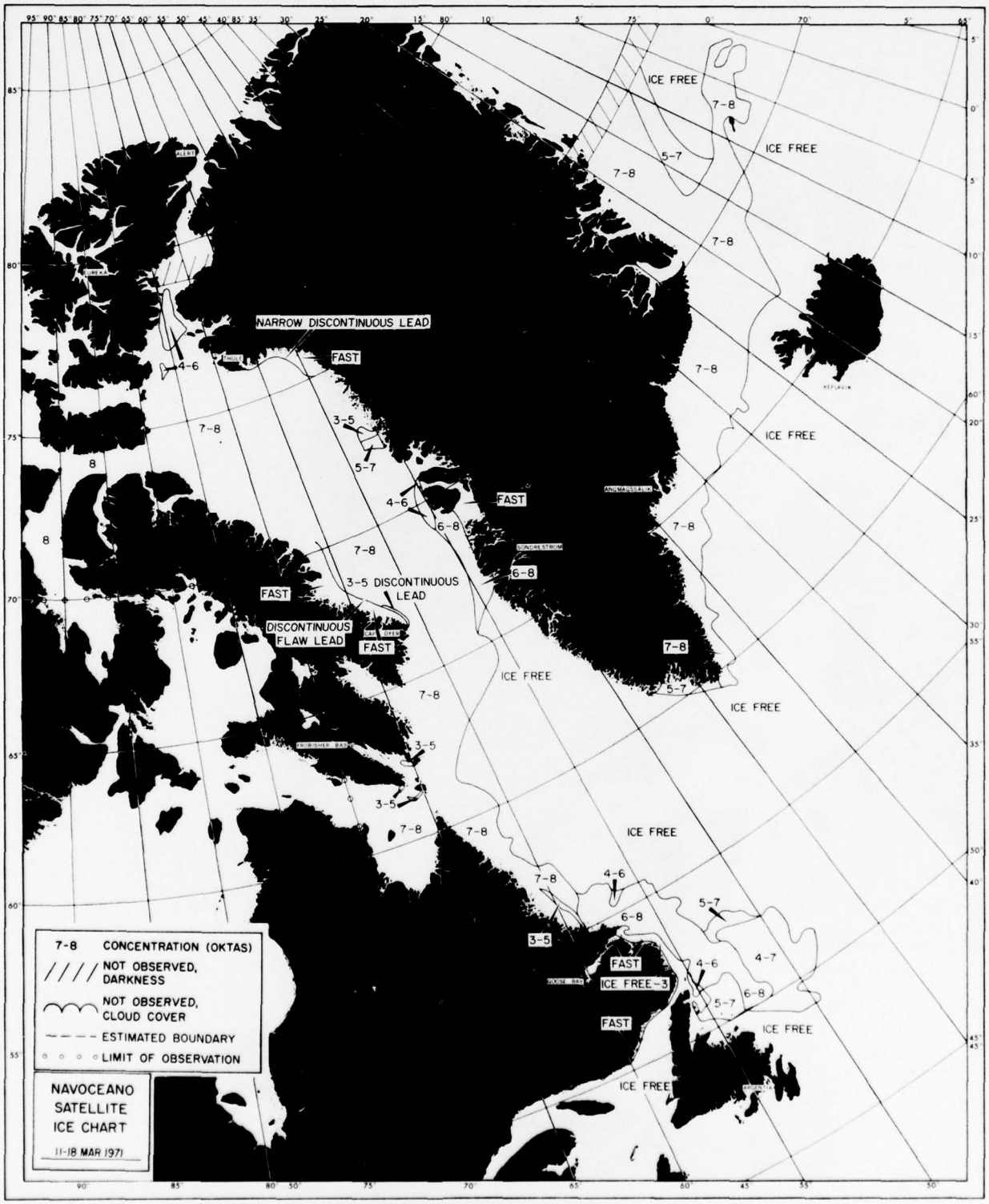
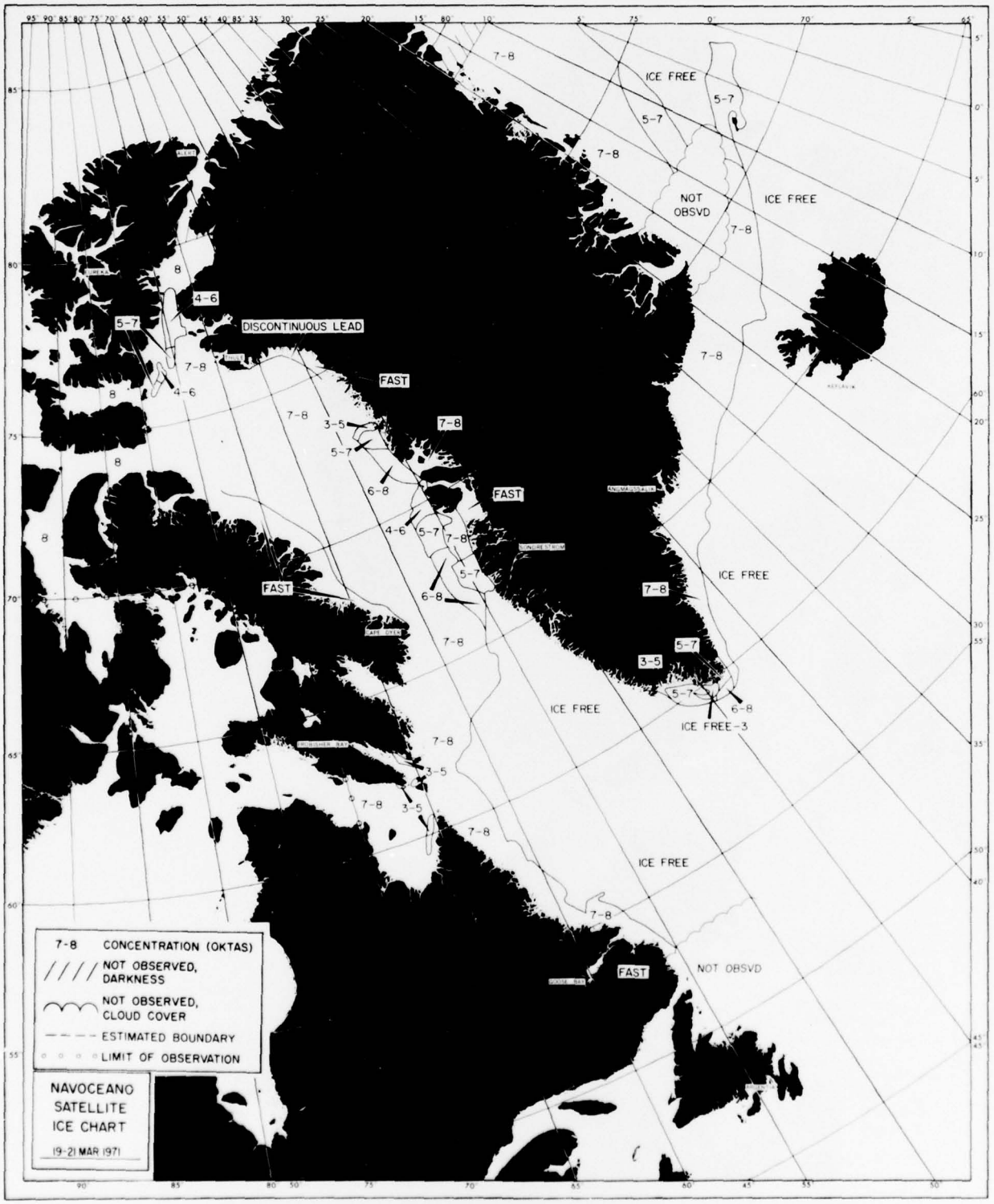
ICE CHART
21-24 DEC 1971

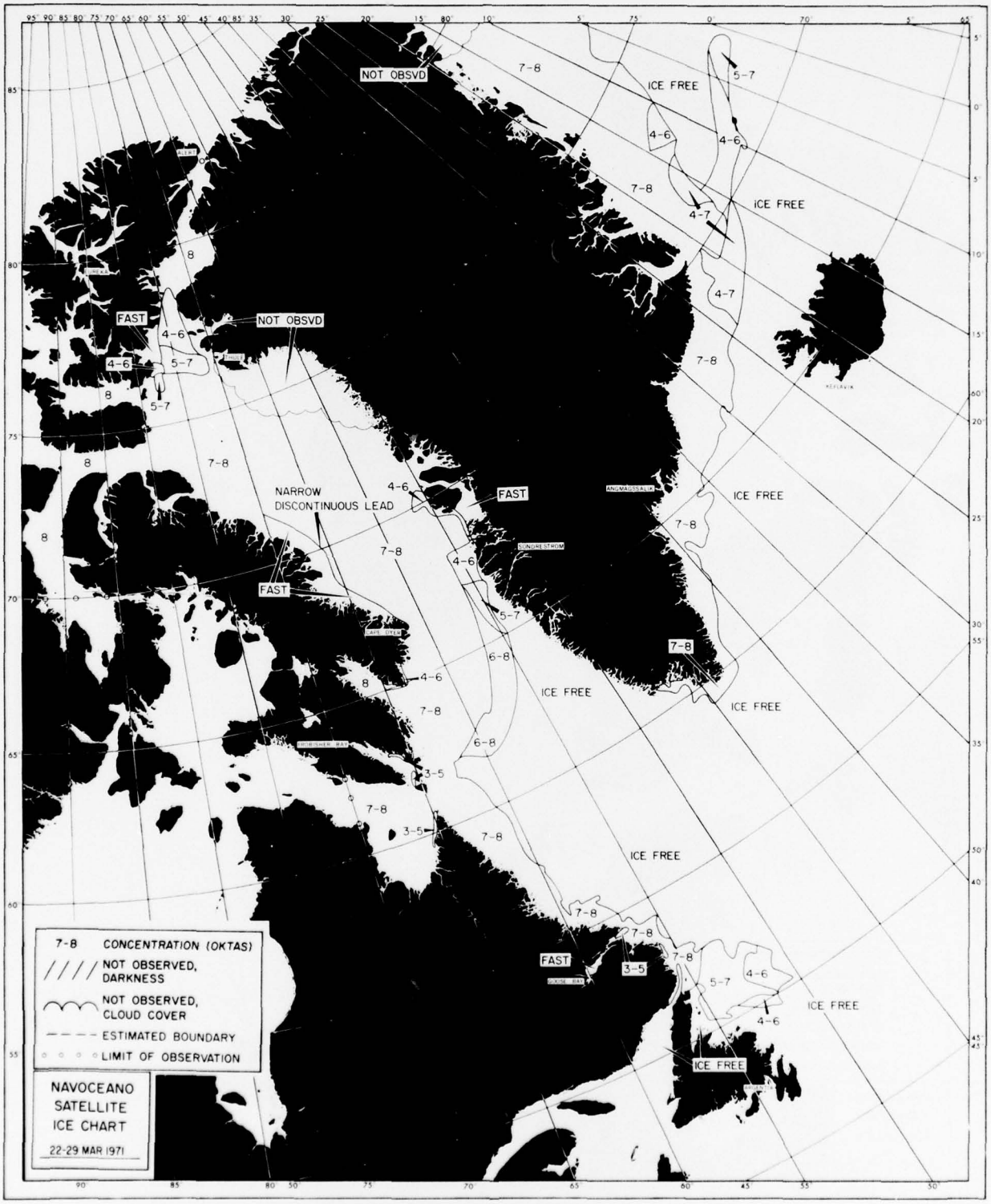
APPENDIX B

EASTERN ARCTIC SATELLITE

ICE CHARTS




7-8
ICE FREE
5-7
5-7
7-8
NOT OBSVD
ICE FREE
7-8
8
4-6
5-7
DISCONTINUOUS LEAD
7-8
4-6
FAST
7-8
3-5
7-8
5-7
6-8
FAST
4-6
5-7
7-8
5-7
ICE FREE
FAST
6-8
7-8
5-7
3-5
5-7
6-8
ICE FREE-3
7-8
ICE FREE
3-5
7-8
3-5
7-8
ICE FREE
7-8
FAST
NOT OBSVD
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
19-21 MAR 1971


NOT OBSVD
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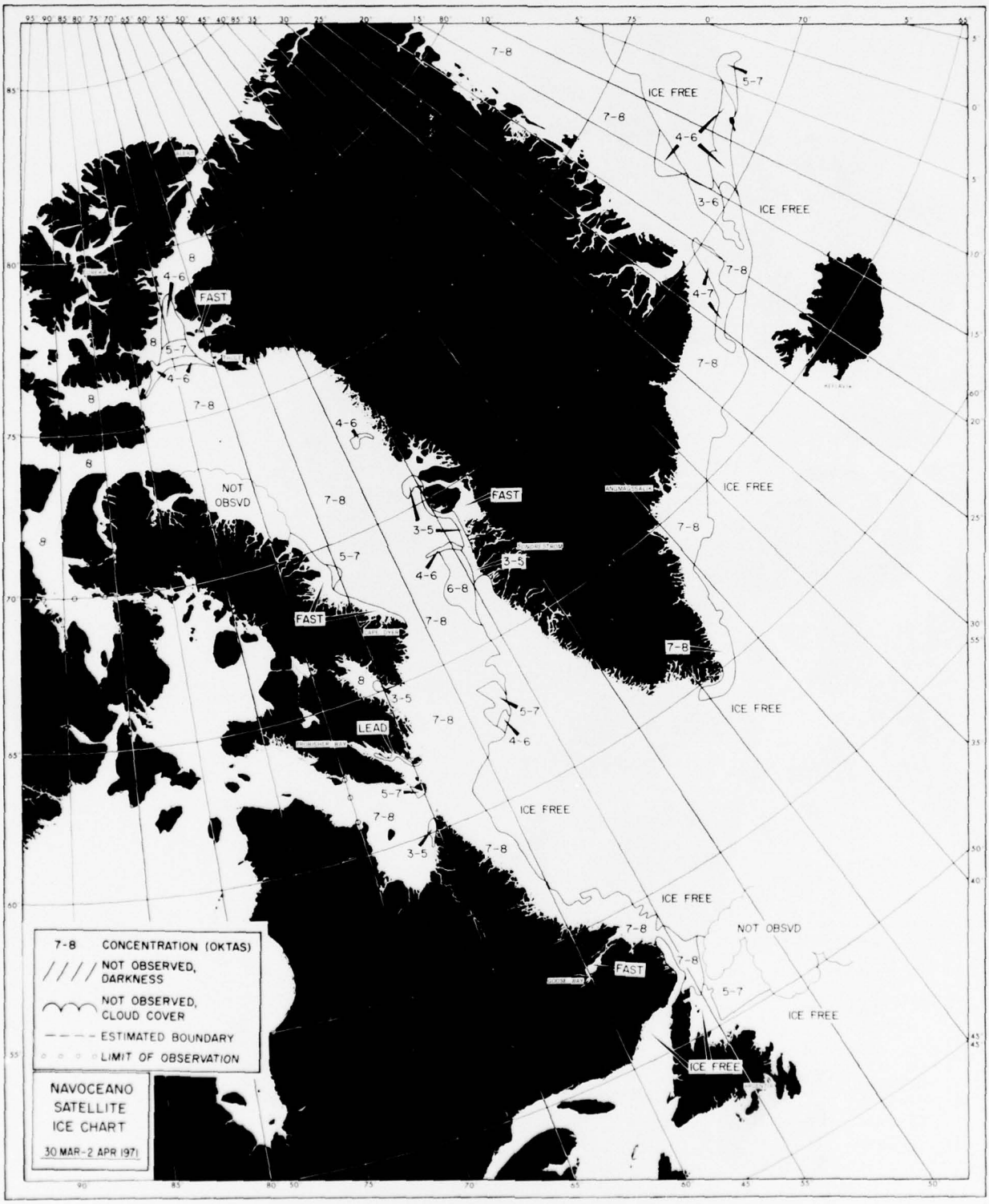
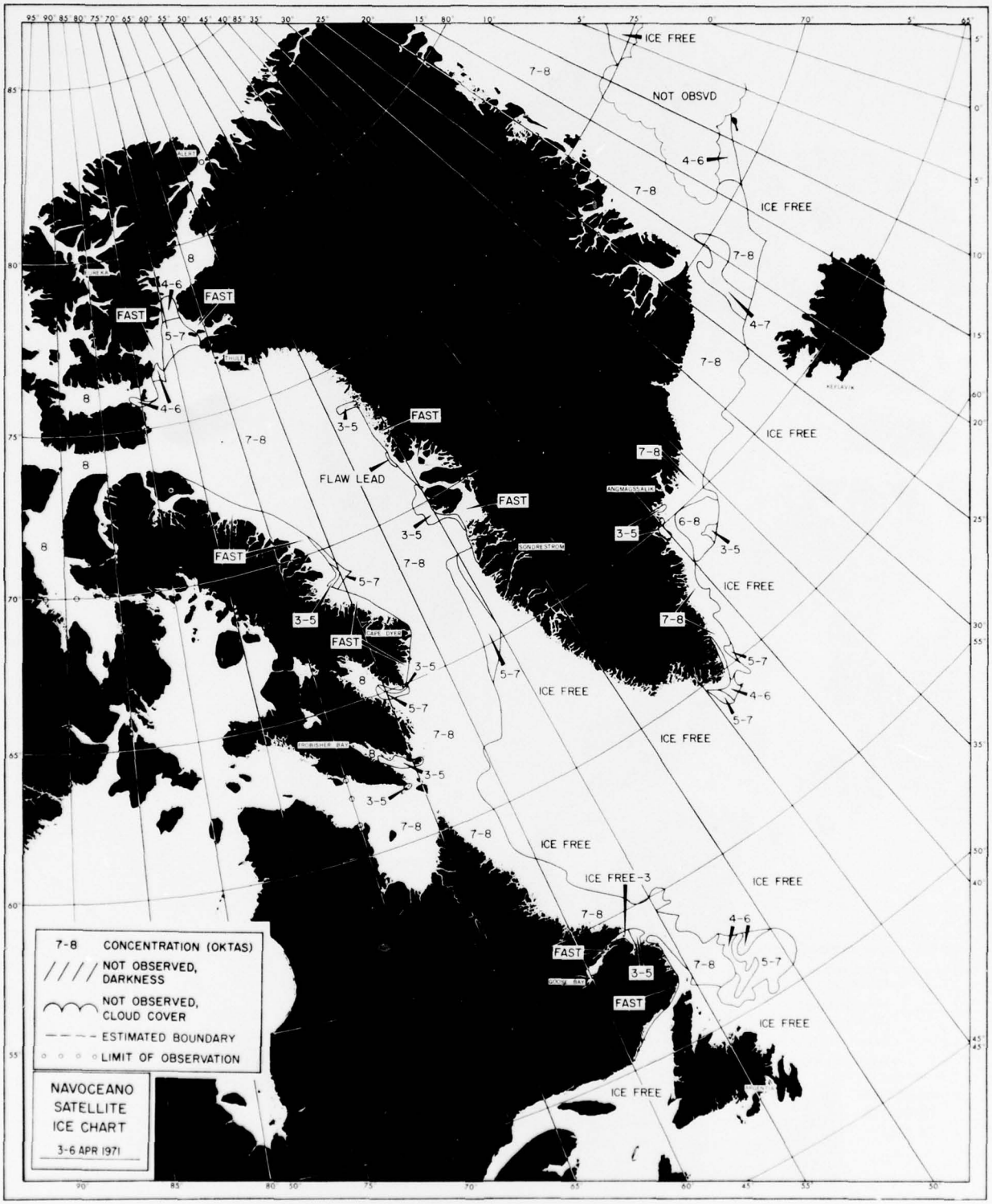
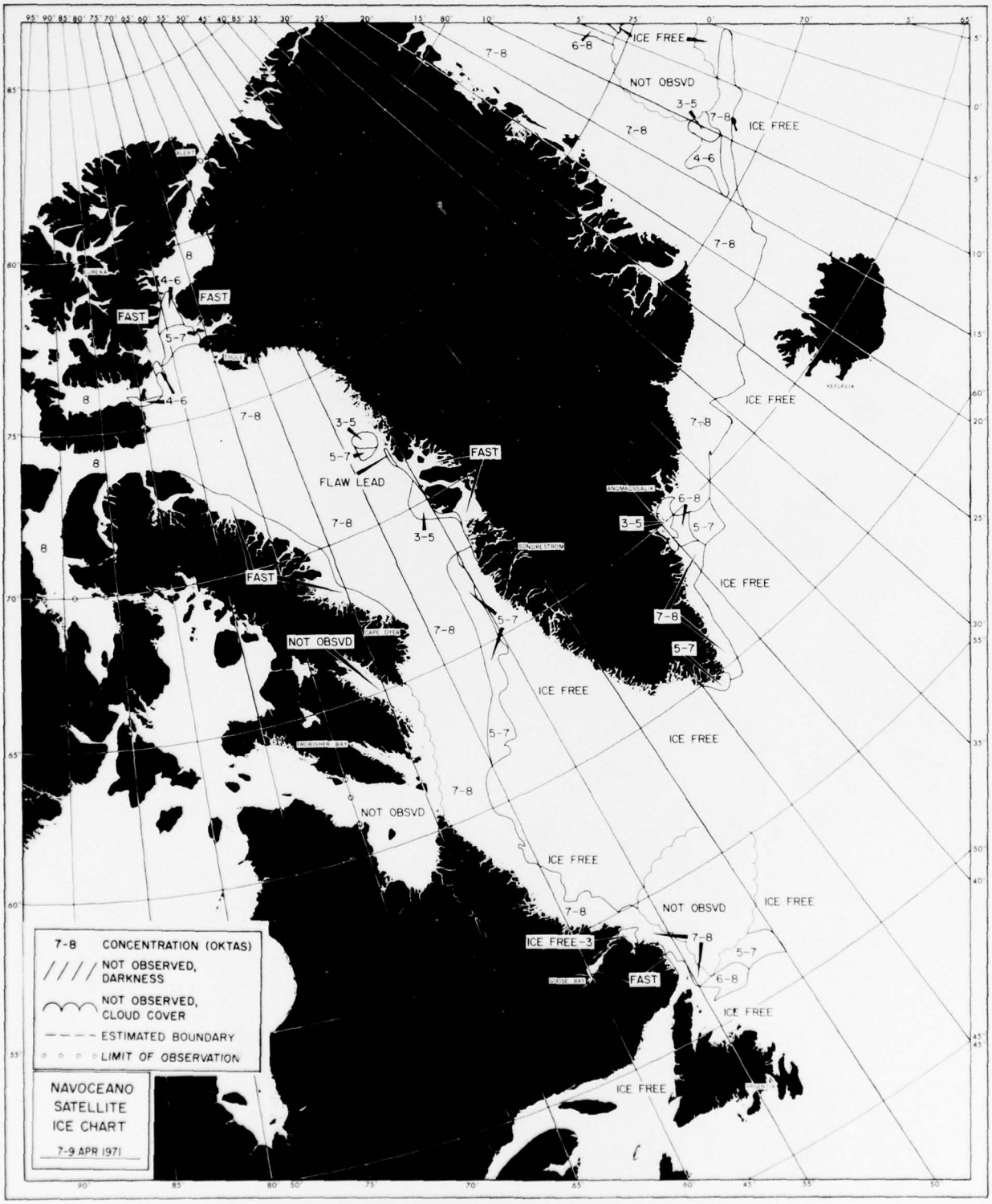
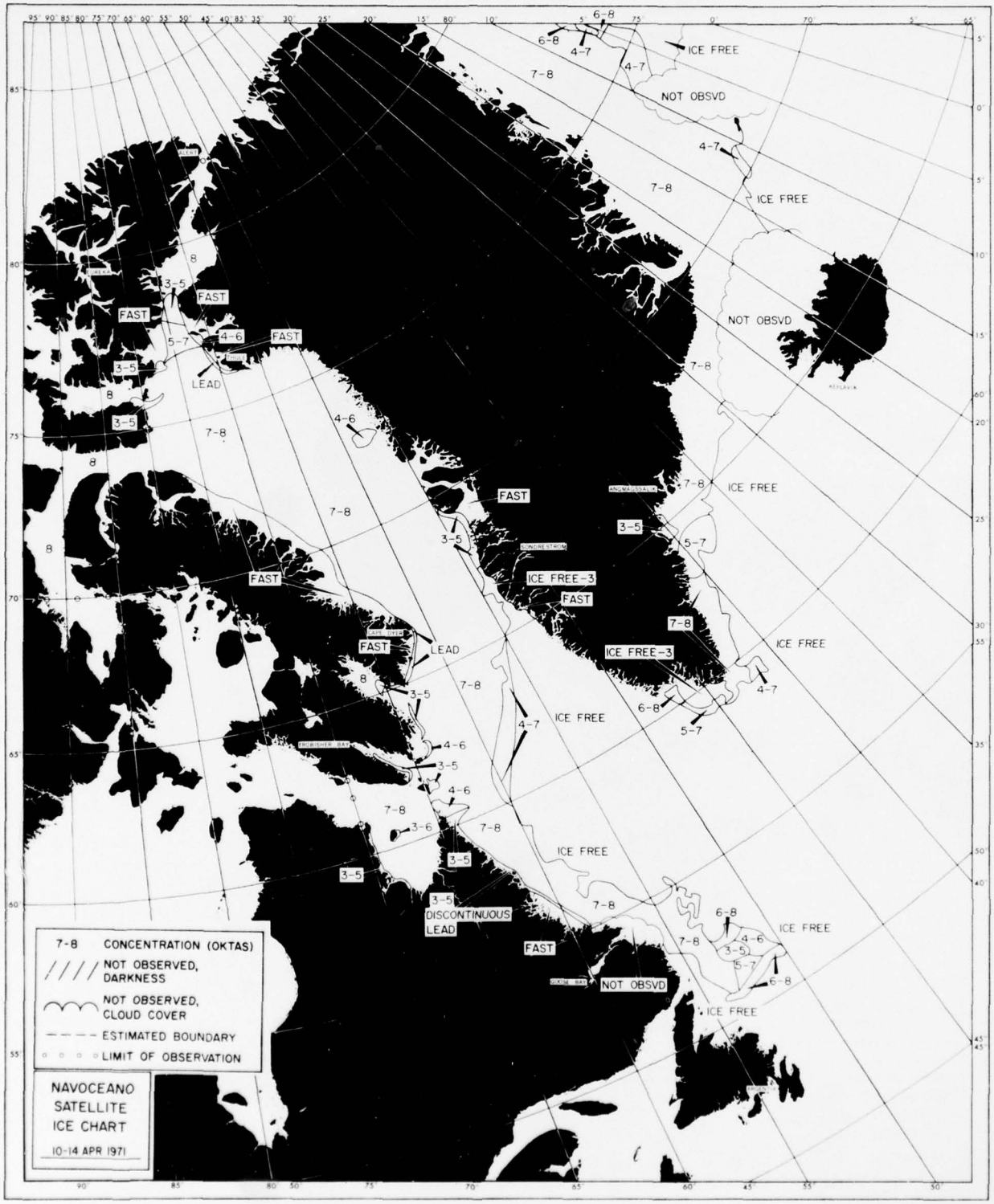
ICE FREE
5-7
4-6
4-6
7-8
4-7
ICE FREE
4-7
8
FAST
4-6
NOT OBSVD
4-6
5-7
7-8
8
5-7
8
7-8
NARROW
DISCONTINUOUS LEAD
4-6
FAST
ANGMAGSSALIK
ICE FREE
7-8
8
7-8
SUNDRESTROM
4-6
FAST
5-7
7-8
6-8
8
4-6
ICE FREE
ICE FREE
7-8
6-8
3-5
7-8
3-5
7-8
ICE FREE
7-8
7-8
FAST
3-5
7-8
5-7
4-6
ICE FREE
4-6
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
22-29 MAR 1971


7-8
ICE FREE
5-7
4-6
3-6
7-8
4-7
FAST
NOT OBSVD
3-5
6-8
LEAD
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
30 MAR-2 APR 1971


ICE FREE
NOT OBSVD
7-8
4-6
ICE FREE
FAST
5-7
3-5
FLAW LEAD
6-8
ICE FREE-3
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
3-6 APR 1971


ICE FREE
6-8
7-8
NOT OBSVD
3-5
7-8
ICE FREE
7-8
4-6
7-8
8
4-6
FAST
FAST
5-7
8
4-6
7-8
ICE FREE
7-8
3-5
5-7
FAST
FLAW LEAD
8
7-8
3-5
6-8
3-5
5-7
8
FAST
ICE FREE
7-8
NOT OBSVD
5-7
5-7
ICE FREE
5-7
ICE FREE
7-8
NOT OBSVD
ICE FREE
7-8
NOT OBSVD
ICE FREE
7-8
ICE FREE-3
7-8
5-7
6-8
FAST
ICE FREE
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
7-9 APR 1971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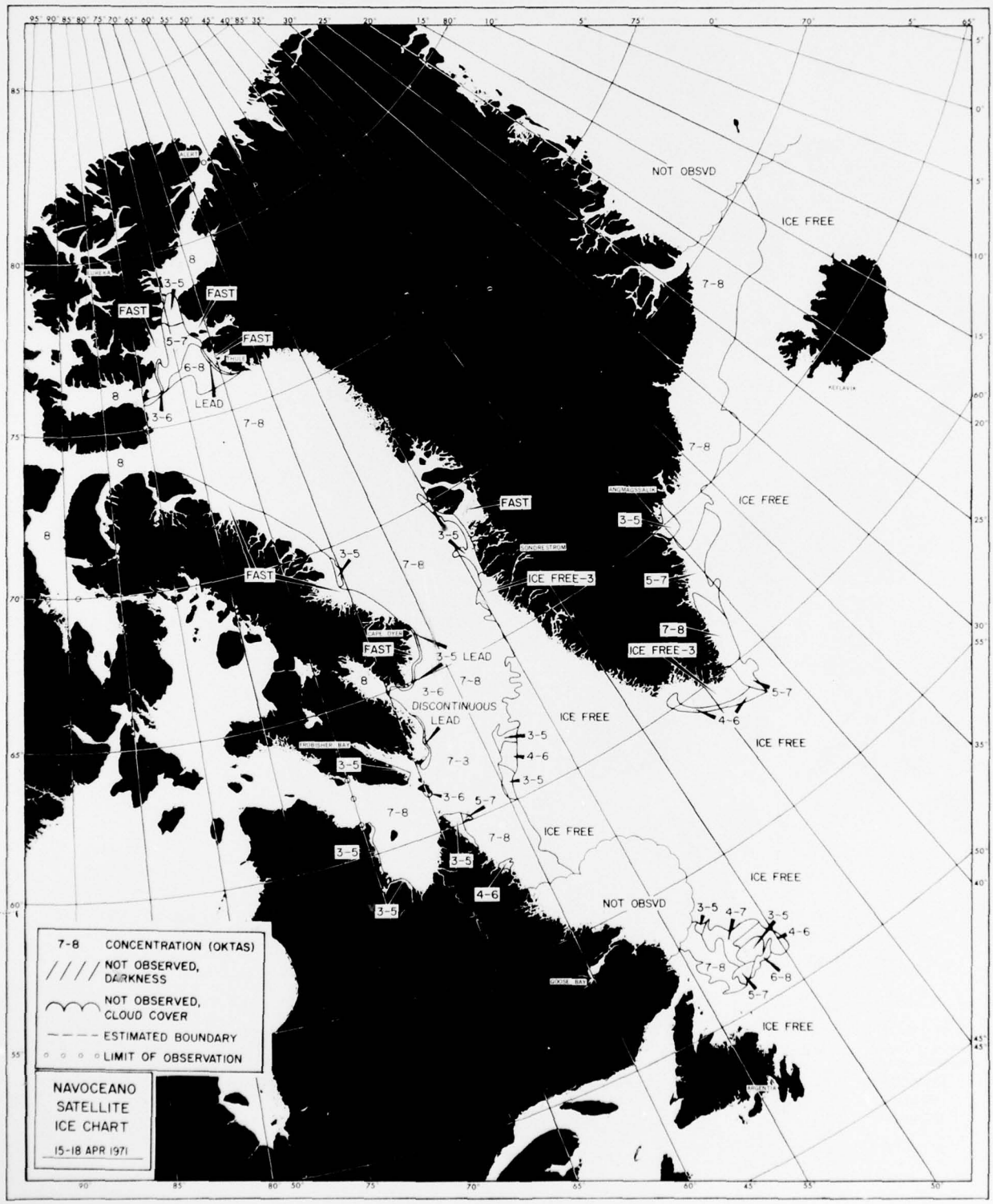
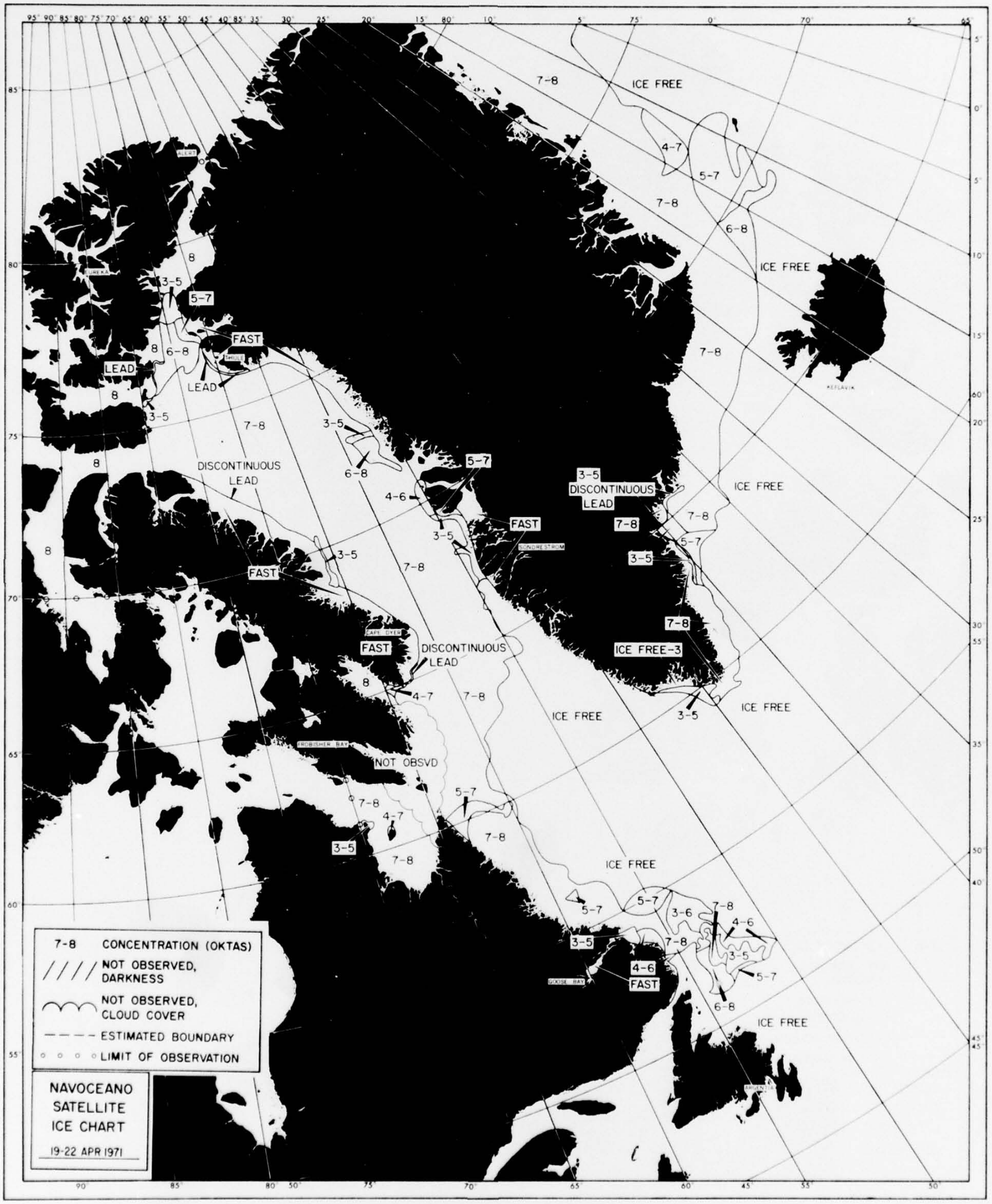
NOT OBSVD
FAST
LEAD
DISCONTINUOUS LEAD
ICE FREE-3
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
10-14 APR 1971


NOT OBSVD
ICE FREE
7-8
FAST
3-5
5-7
6-8
LEAD
3-6
ICE FREE-3
3-5 LEAD
DISCONTINUOUS LEAD
4-6
7-3
4-7
NOT OBSVD
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
15-18 APR 1971


7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
19-22 APR 1971
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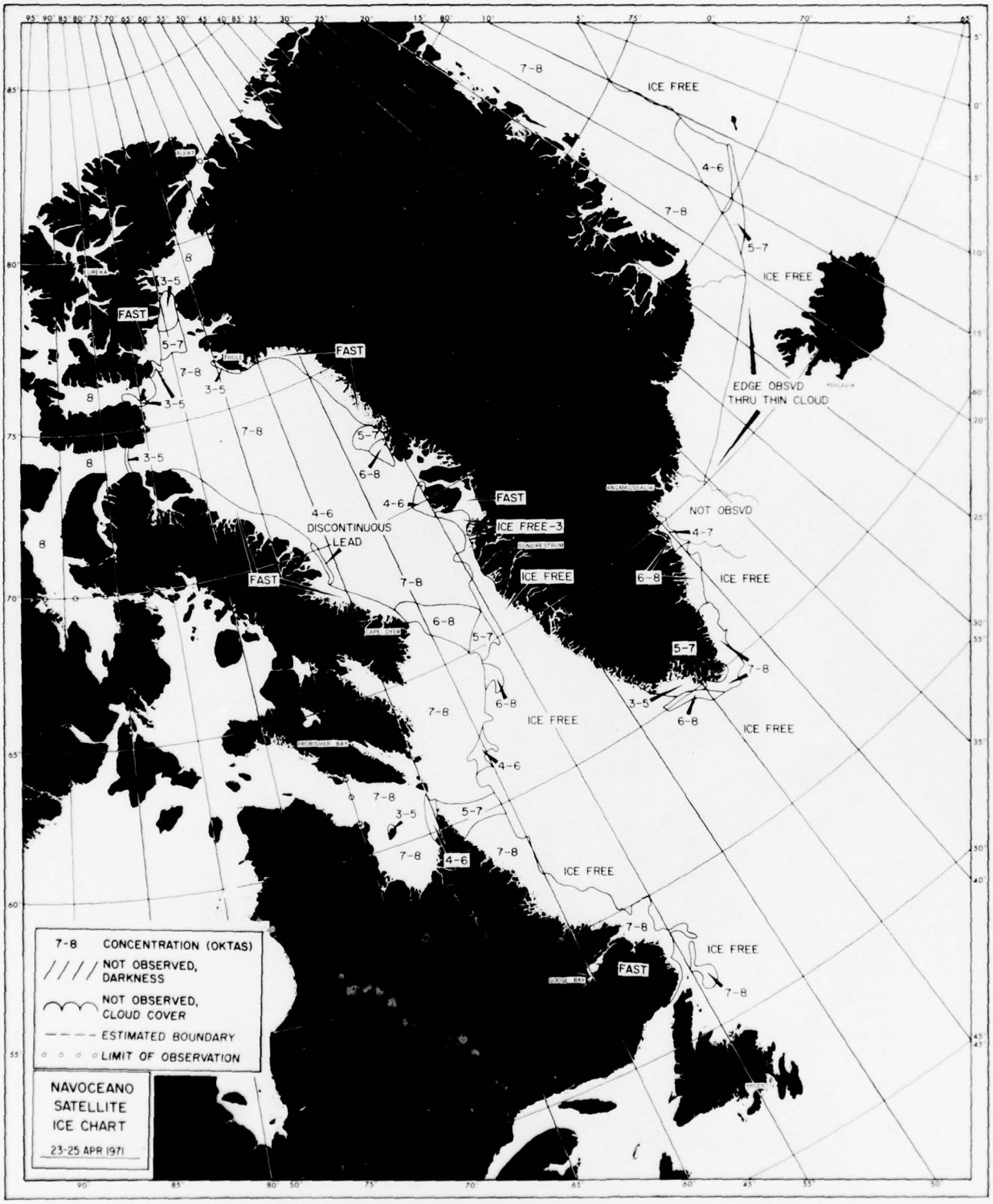
FAST
LEAD
NOT OBSVD
ICE FREE-3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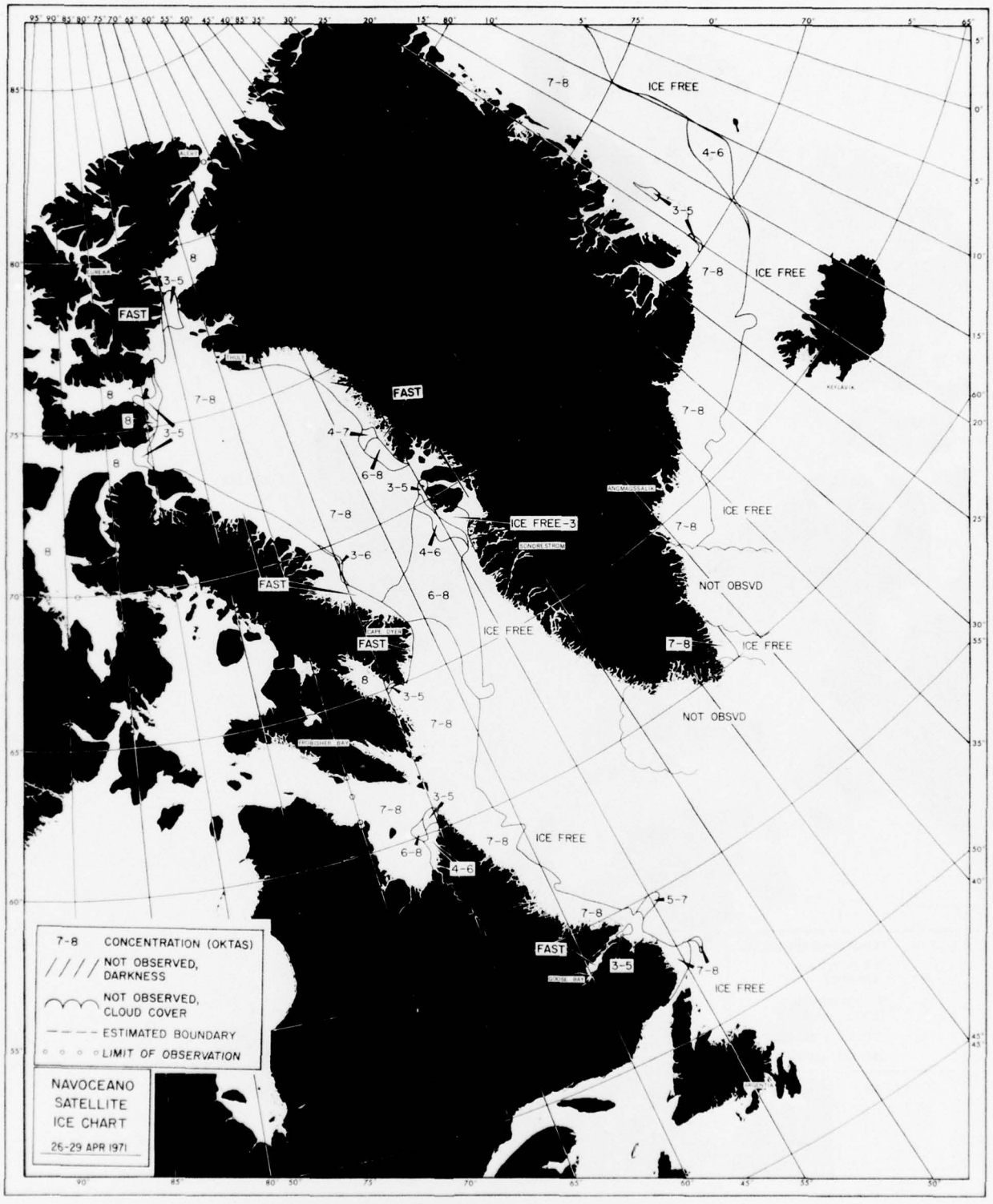
4-6
7-8
5-7
ICE FREE
FAST
3-5
5-7
7-8
3-5
FAST
EDGE OBSVD
THRU THIN CLOUD
8
3-5
7-8
5-7
6-8
4-6
4-6
FAST
NOT OBSVD
4-6
DISCONTINUOUS
LEAD
ICE FREE-3
FAST
7-8
ICE FREE
6-8
ICE FREE
6-8
5-7
5-7
7-8
6-8
3-5
6-8
7-8
ICE FREE
ICE FREE
4-6
7-8
3-5
5-7
7-8
4-6
7-8
ICE FREE
7-8
ICE FREE
FAST
7-8
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
23-25 APR 1971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ICE FREE
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3-5
7-8
ICE FREE
FAST
8
3-5
7-8
FAST
8
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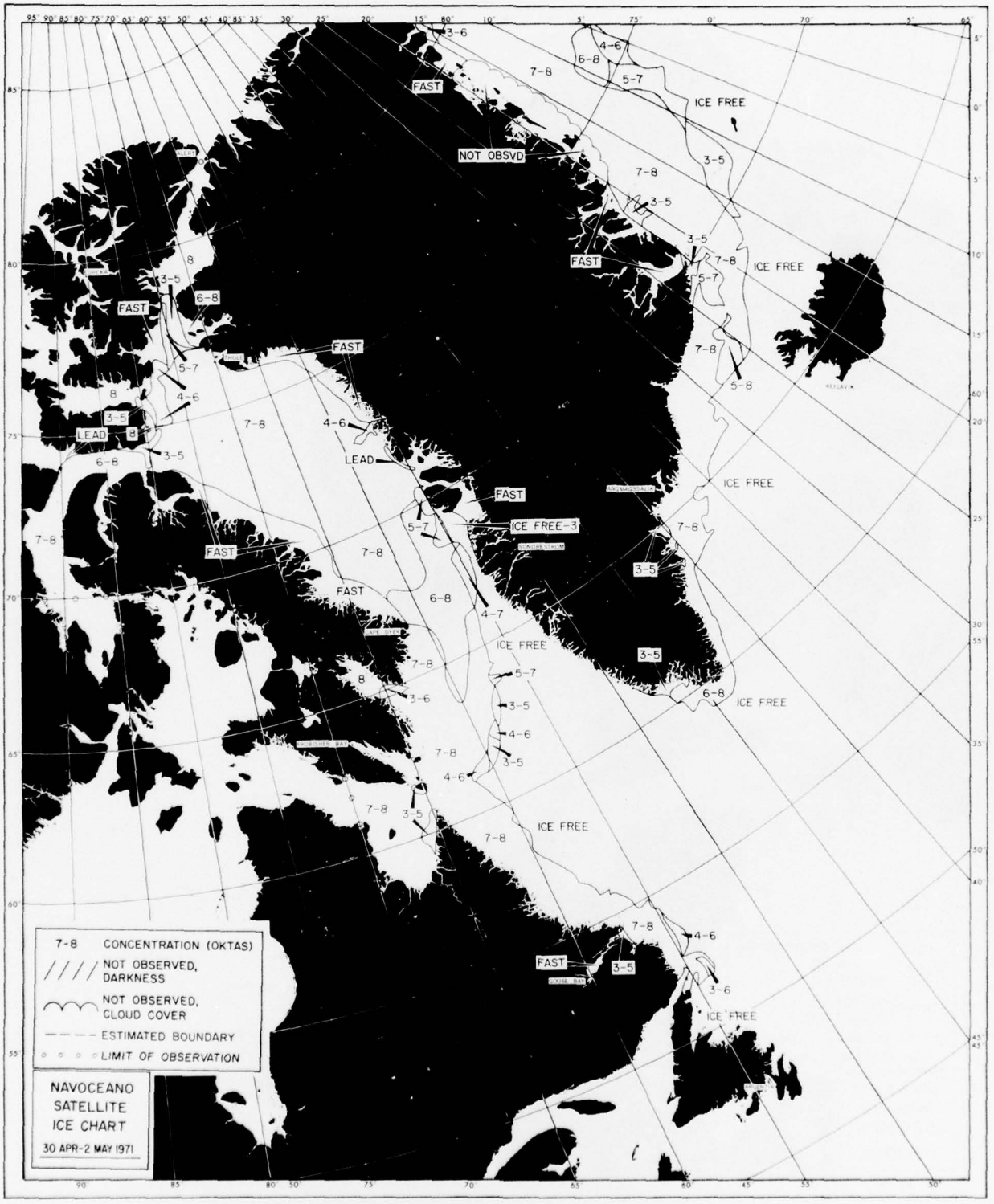
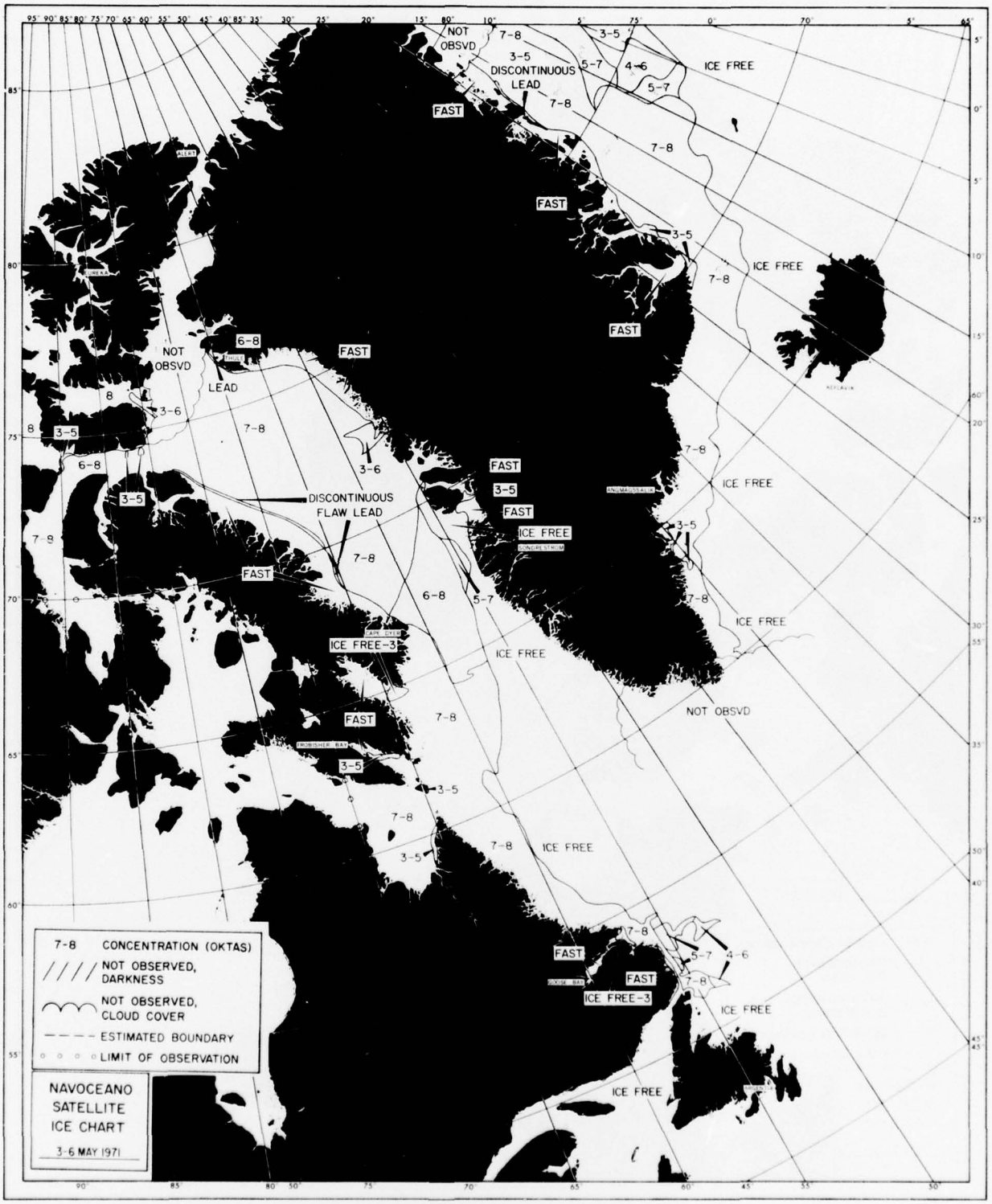
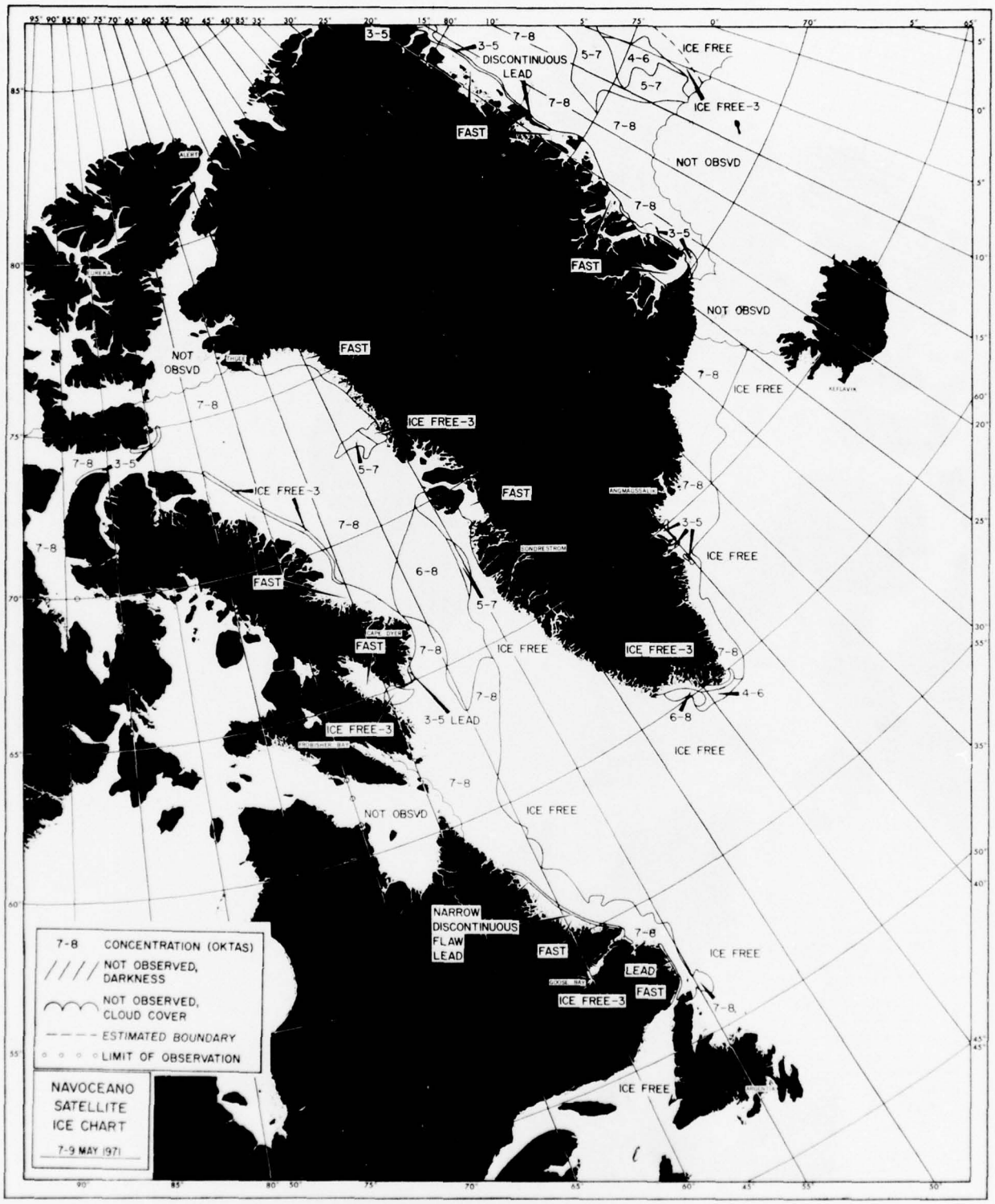
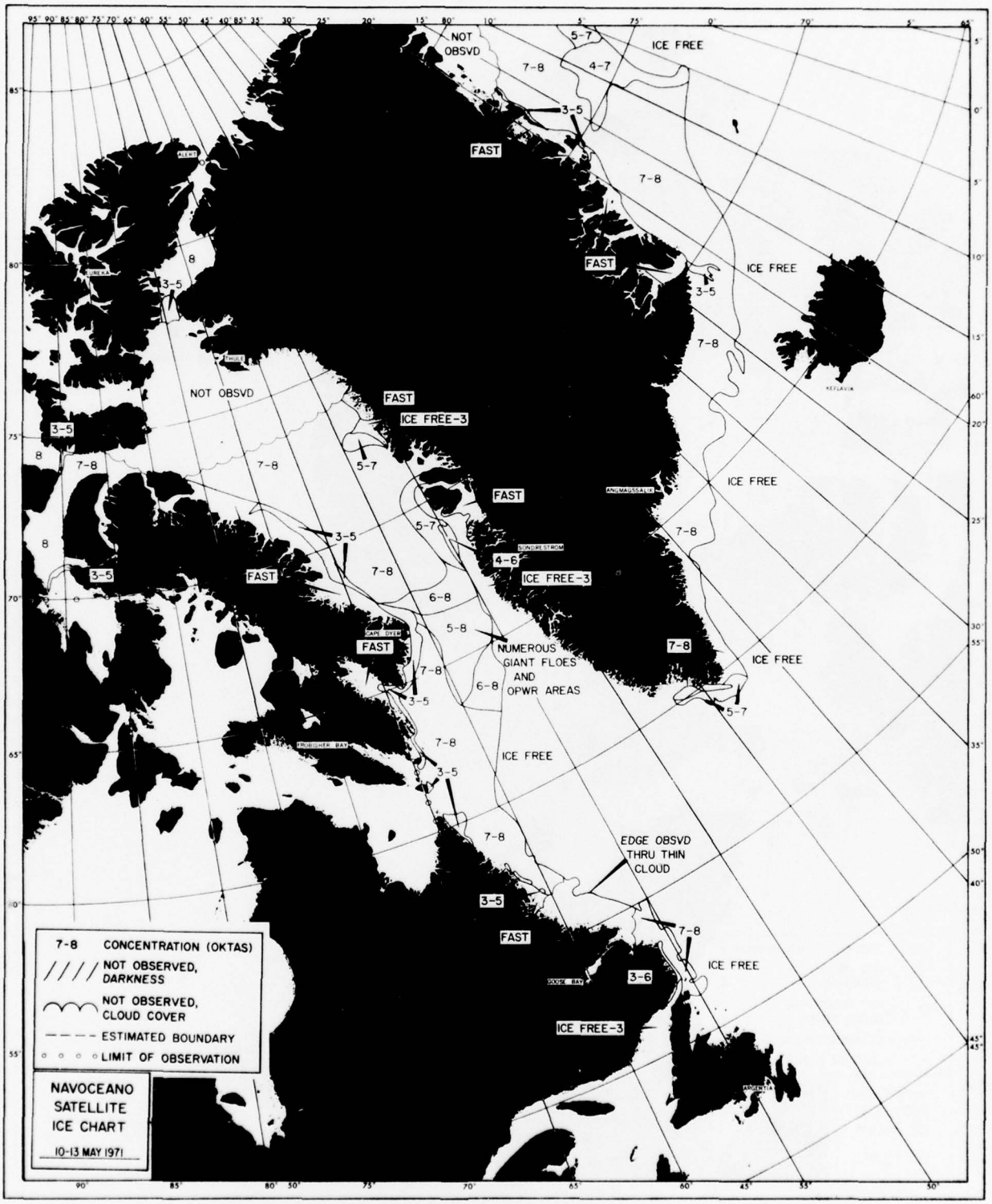
3-5
4-7
6-8
3-5
ICE FREE-3
7-8
ICE FREE
7-8
3-6
4-6
FAST
6-8
NOT OBSVD
ICE FREE
FAST
7-8
ICE FREE
8
3-5
7-8
NOT OBSVD
3-5
7-8
ICE FREE
6-8
4-6
5-7
7-8
FAST
3-5
7-8
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
26-29 APR 1971


7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
30 APR-2 MAY 1971
FAST
NOT OBSVD
ICE FREE
LEAD
ICE FREE-3


NOT OBSVD
7-8
3-5
DISCONTINUOUS LEAD
5-7
4-6
ICE FREE
FAST
7-8
3-5
ICE FREE
FAST
6-8
NOT OBSVD
LEAD
FAST
8
3-6
8
3-5
7-8
6-8
3-6
FAST
3-5
FAST
ICE FREE
3-5
DISCONTINUOUS FLAW LEAD
7-8
7-8
FAST
6-8
5-7
7-8
ICE FREE
ICE FREE-3
ICE FREE
NOT OBSVD
FAST
7-8
3-5
3-5
7-8
7-8
ICE FREE
FAST
5-7
4-6
FAST
7-8
ICE FREE-3
ICE FREE
ICE FREE
7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
3-6 MAY 1971


3-5
7-8
3-5
DISCONTINUOUS
LEAD
5-7
4-6
ICE FREE
5-7
7-8
ICE FREE-3
7-8
FAST
NOT OBSVD
7-8
3-5
FAST
NOT OBSVD
NOT
OBSVD
7-8
ICE FREE
7-8
ICE FREE-3
5-7
7-8
3-5
ICE FREE-3
FAST
7-8
3-5
ICE FREE
7-8
6-8
FAST
5-7
FAST
7-8
ICE FREE
ICE FREE-3
7-8
4-6
7-8
3-5 LEAD
6-8
ICE FREE-3
ICE FREE
7-8
NOT OBSVD
ICE FREE
NARROW
DISCONTINUOUS
FLAW
LEAD
7-8
FAST
ICE FREE
LEAD
FAST
ICE FREE-3
7-8
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO
SATELLITE
ICE CHART
7-9 MAY 1971


NOT OBSVD
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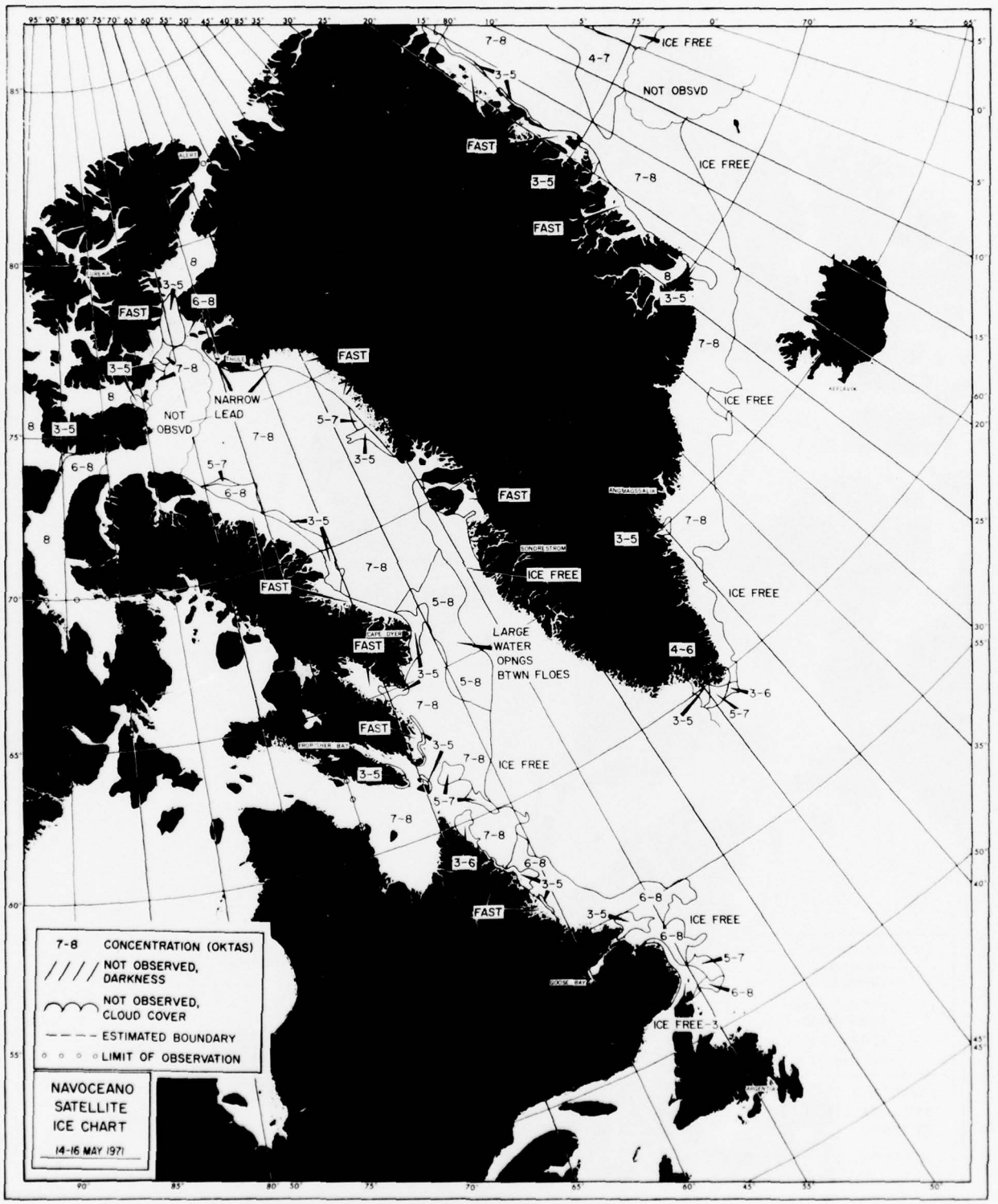
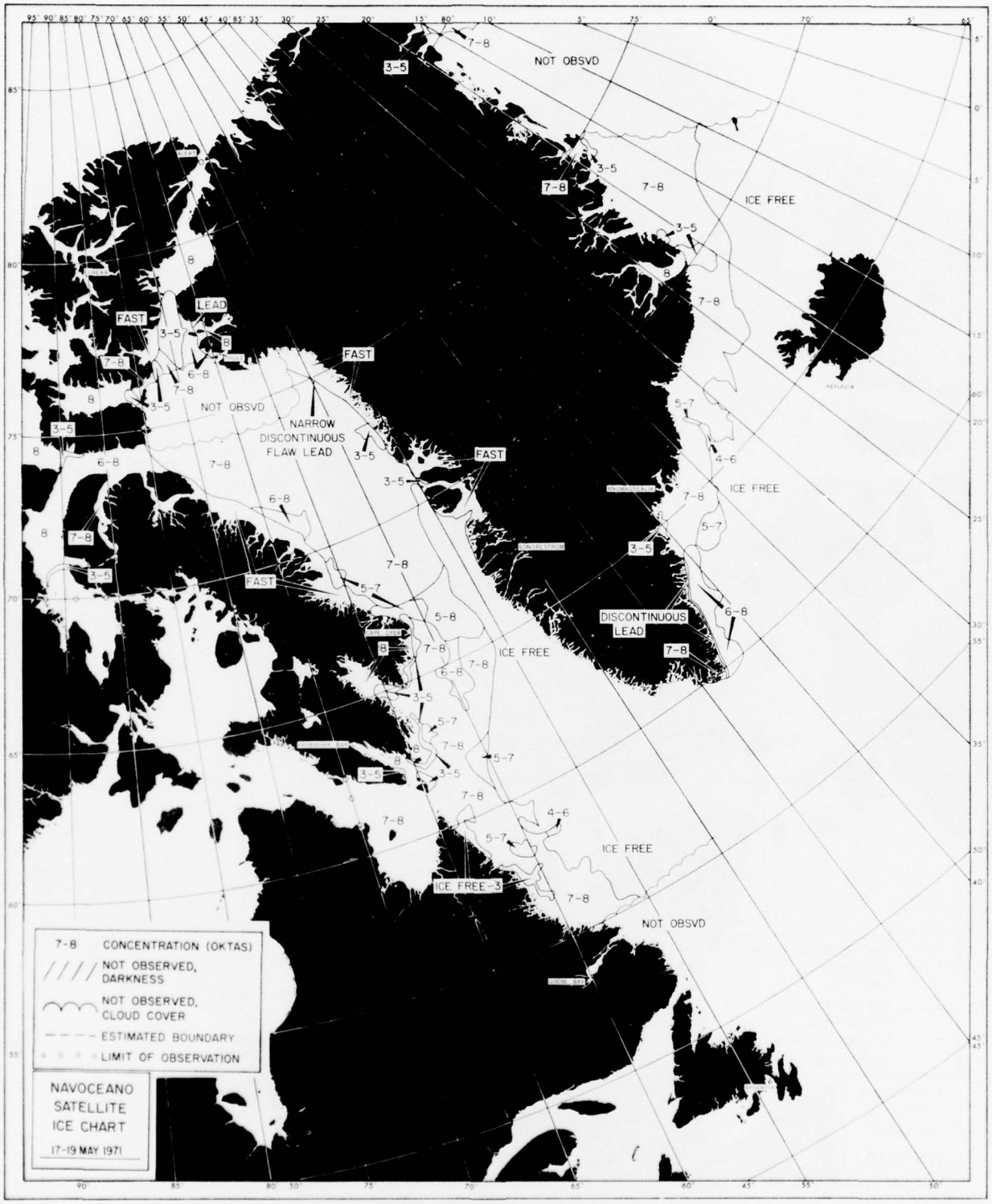
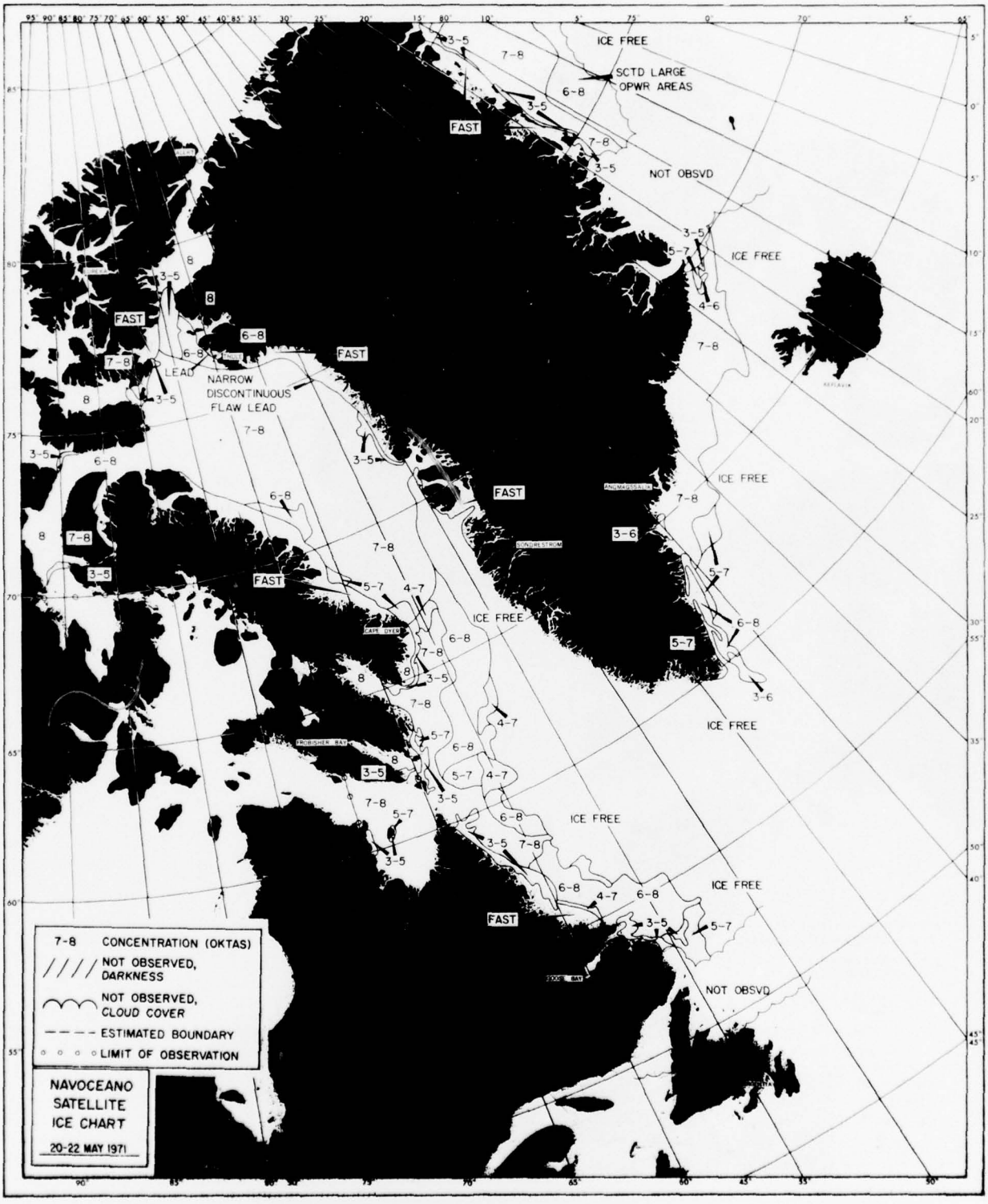
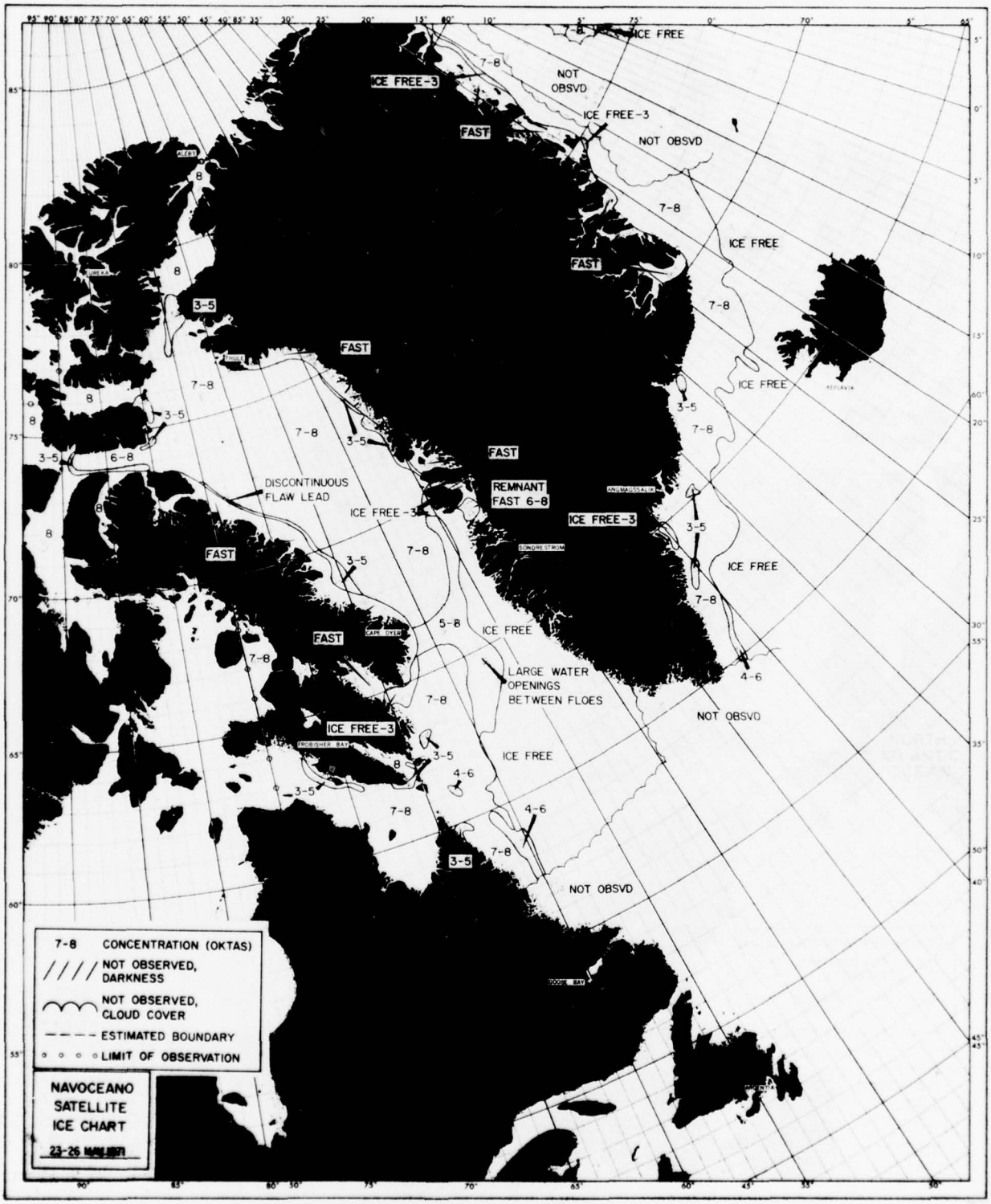
ICE FREE
7-8
4-7
3-5
FAST
7-8
8
3-5
FAST
ICE FREE
3-5
7-8
THULE
NOT OBSVD
FAST
ICE FREE-3
3-5
8
7-8
7-8
5-7
FAST
ANGMAGSSALIK
ICE FREE
5-7
7-8
3-5
SONDRESTROM
4-6
8
3-5
FAST
7-8
ICE FREE-3
6-8
5-8
CAPE DYER
FAST
NUMEROUS
GIANT FLOES
AND
OPWR AREAS
7-8
7-8
ICE FREE
6-8
3-5
5-7
PROBISHER BAY
7-8
ICE FREE
3-5
7-8
EDGE OBSVD
THRU THIN
CLOUD
3-5
7-8
FAST
ICE FREE
SYDNEY
3-6
ICE FREE-3
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO
SATELLITE
ICE CHART
10-13 MAY 1971


ICE FREE
NOT OBSVD
FAST
NARROW LEAD
LARGE WATER OPNGS BTWN FLOES
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
14-16 MAY 1971


NOT OBSVD
ICE FREE
FAST
LEAD
NARROW
DISCONTINUOUS
FLAW LEAD
DISCONTINUOUS
LEAD
ICE FREE
ICE FREE-3
NOT OBSVD
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
17-19 MAY 1971


ICE FREE
SCTD LARGE
OPWR AREAS
NOT OBSVD
FAST
LEAD
NARROW
DISCONTINUOUS
FLAW LEAD
ICE FREE
7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO
SATELLITE
ICE CHART
20-22 MAY 1971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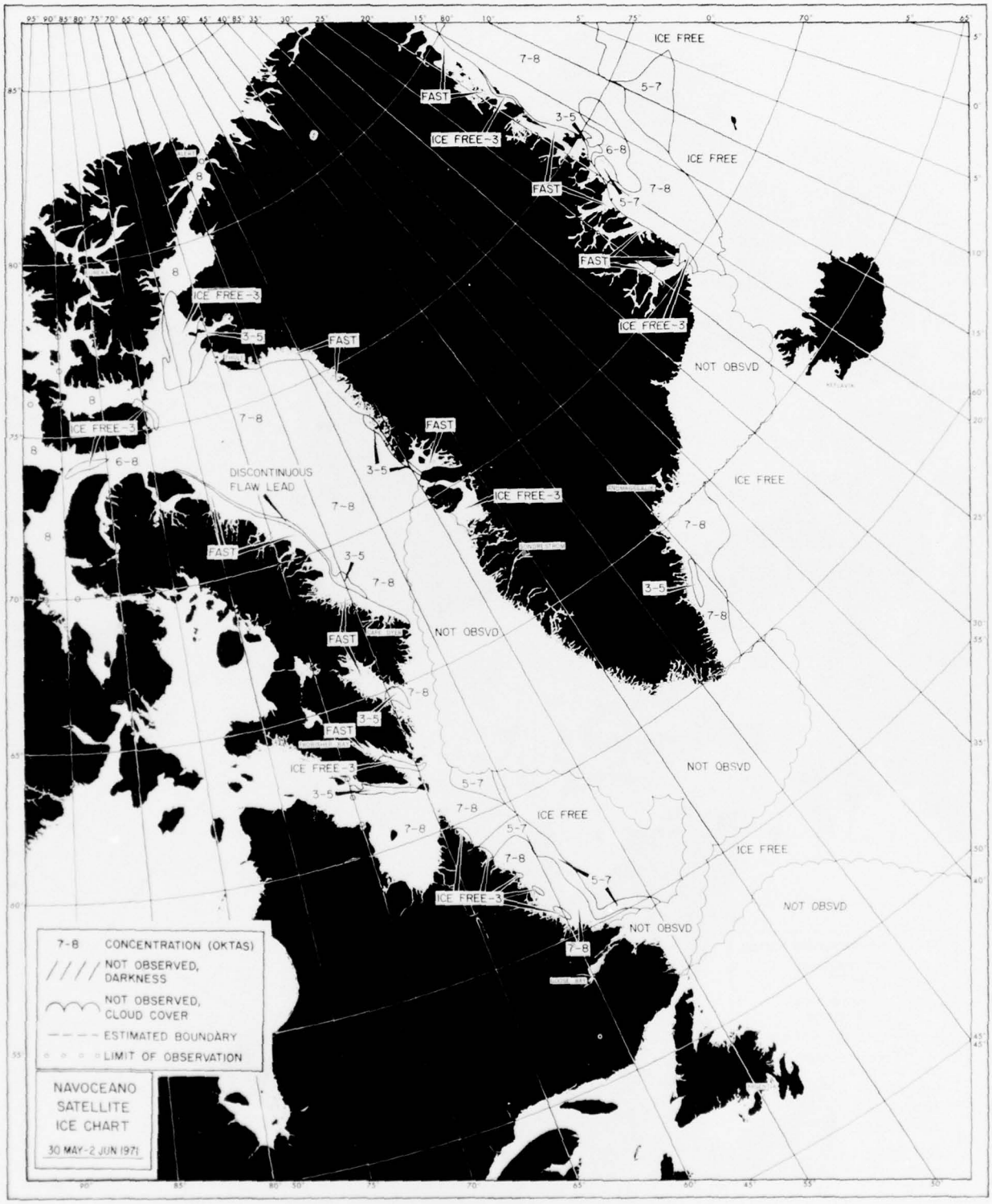
ICE FREE-3
FAST
7-8
ICE FREE
3-5
6-8
DISCONTINUOUS FLAW LEAD
REMNANT FAST 6-8
5-8
LARGE WATER OPENINGS BETWEEN FLOES
4-6
7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
23-26 MAR 1971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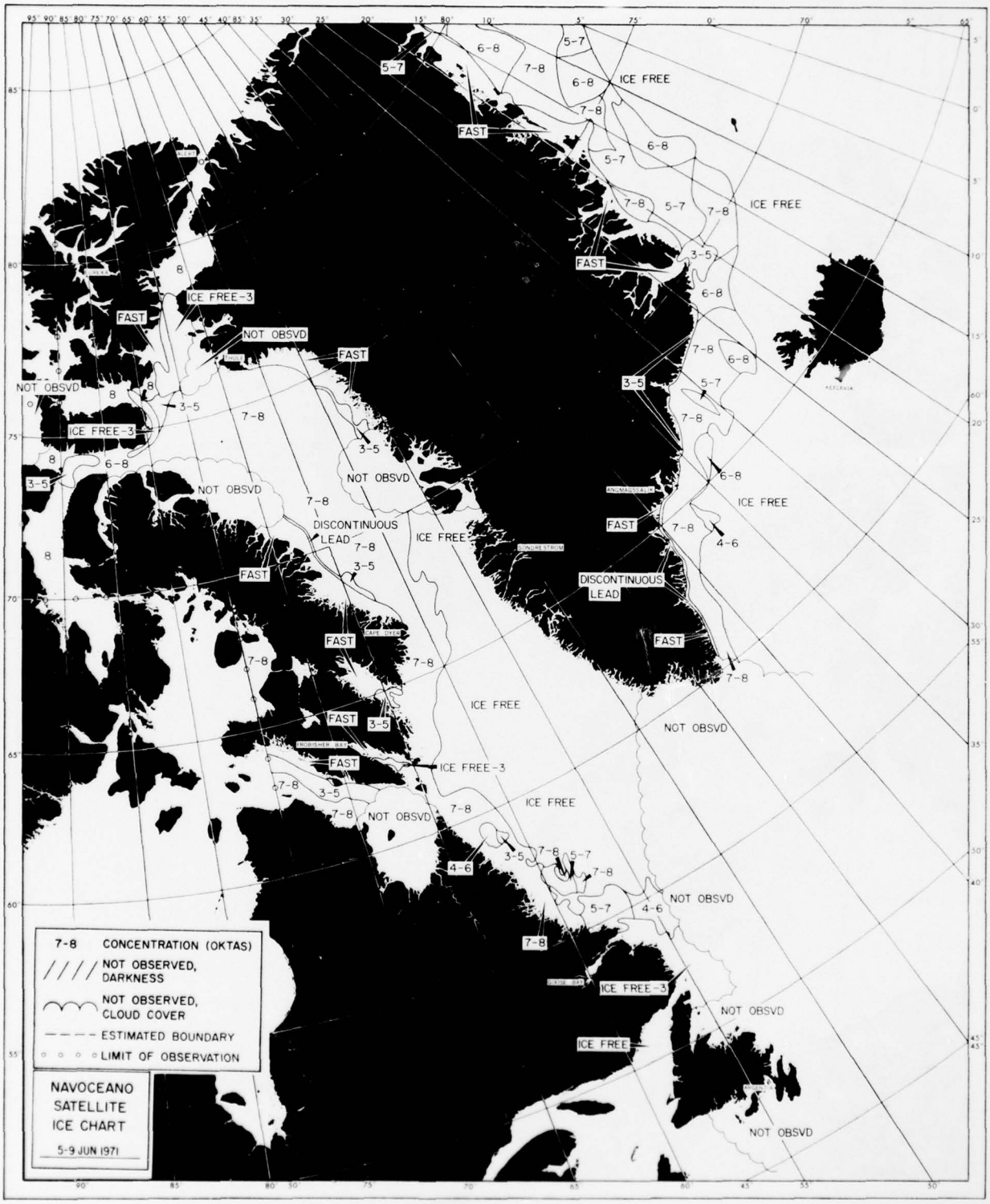
7-8
5-7
FAST
3-5
ICE FREE-3
6-8
8
NOT OBSVD
DISCONTINUOUS
FLAW LEAD
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO
SATELLITE
ICE CHART
30 MAY-2 JUN 1971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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
5-9 JUN 1971
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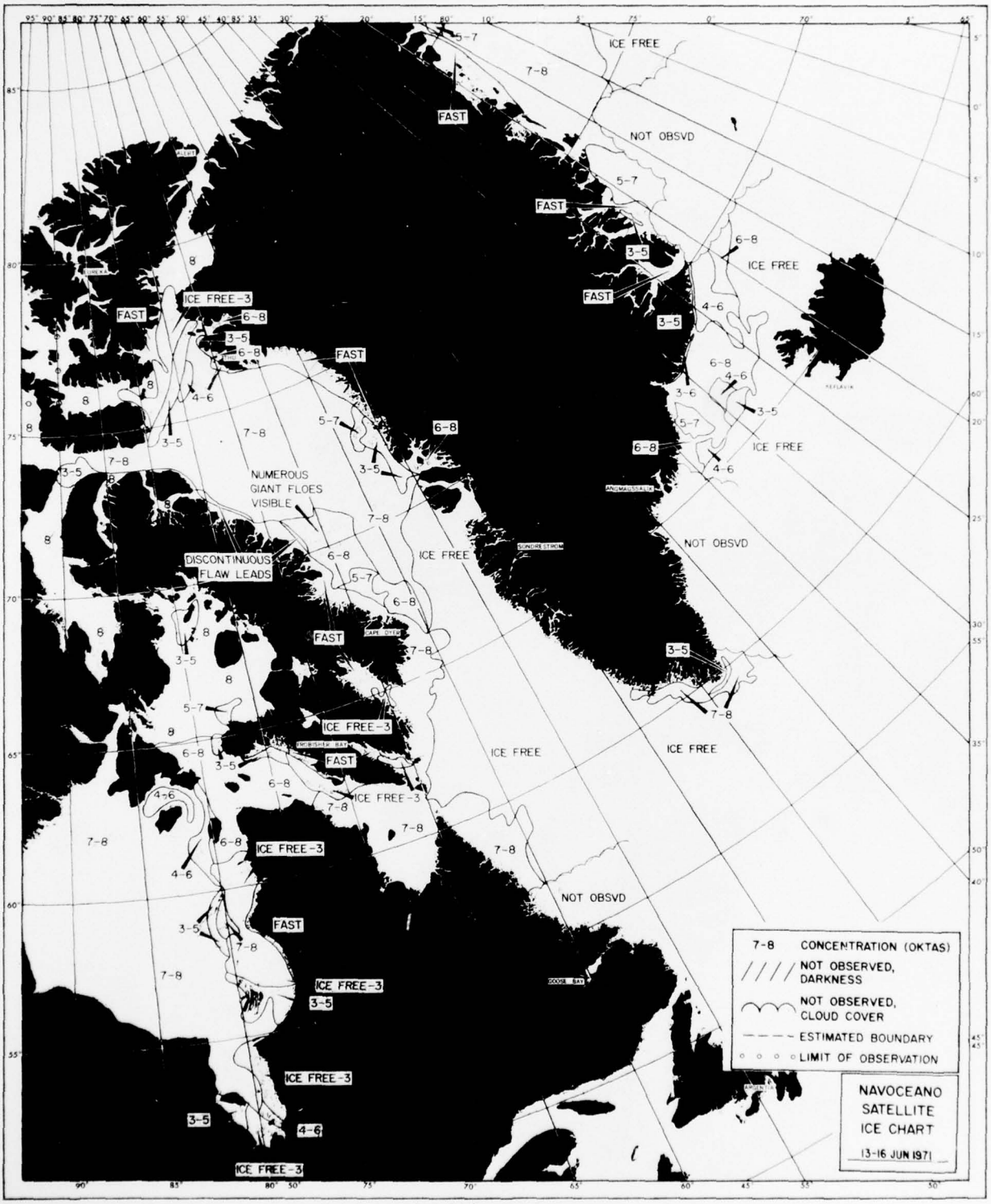
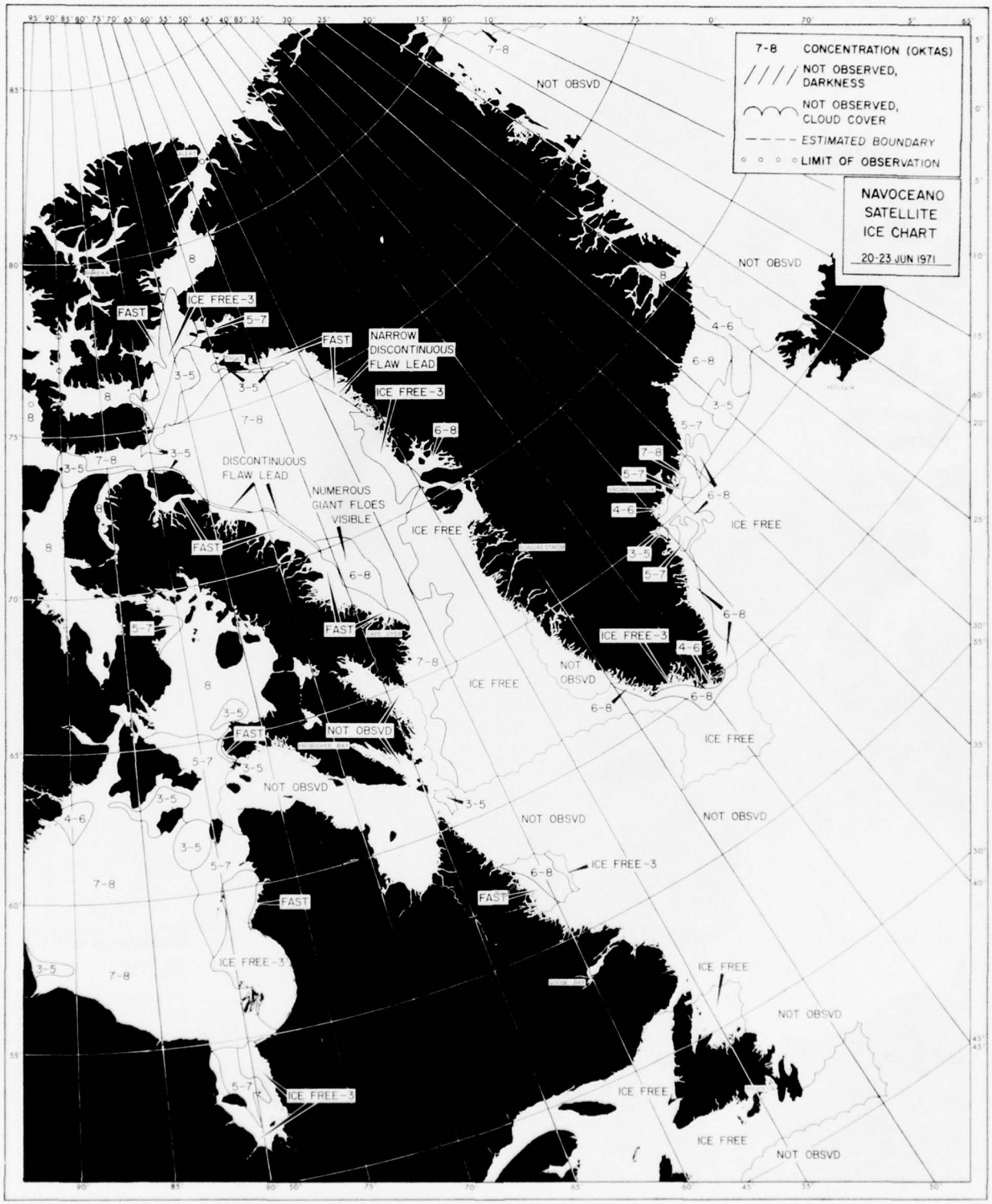
FAST
DISCONTINUOUS LEAD
ICE FREE-3
6-8
7-8
5-7
3-5
4-6


ICE FREE
NOT OBSVD
FAST
ICE FREE-3
NUMEROUS GIANT FLOES VISIBLE
DISCONTINUOUS FLAW LEADS
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
13-16 JUN 1971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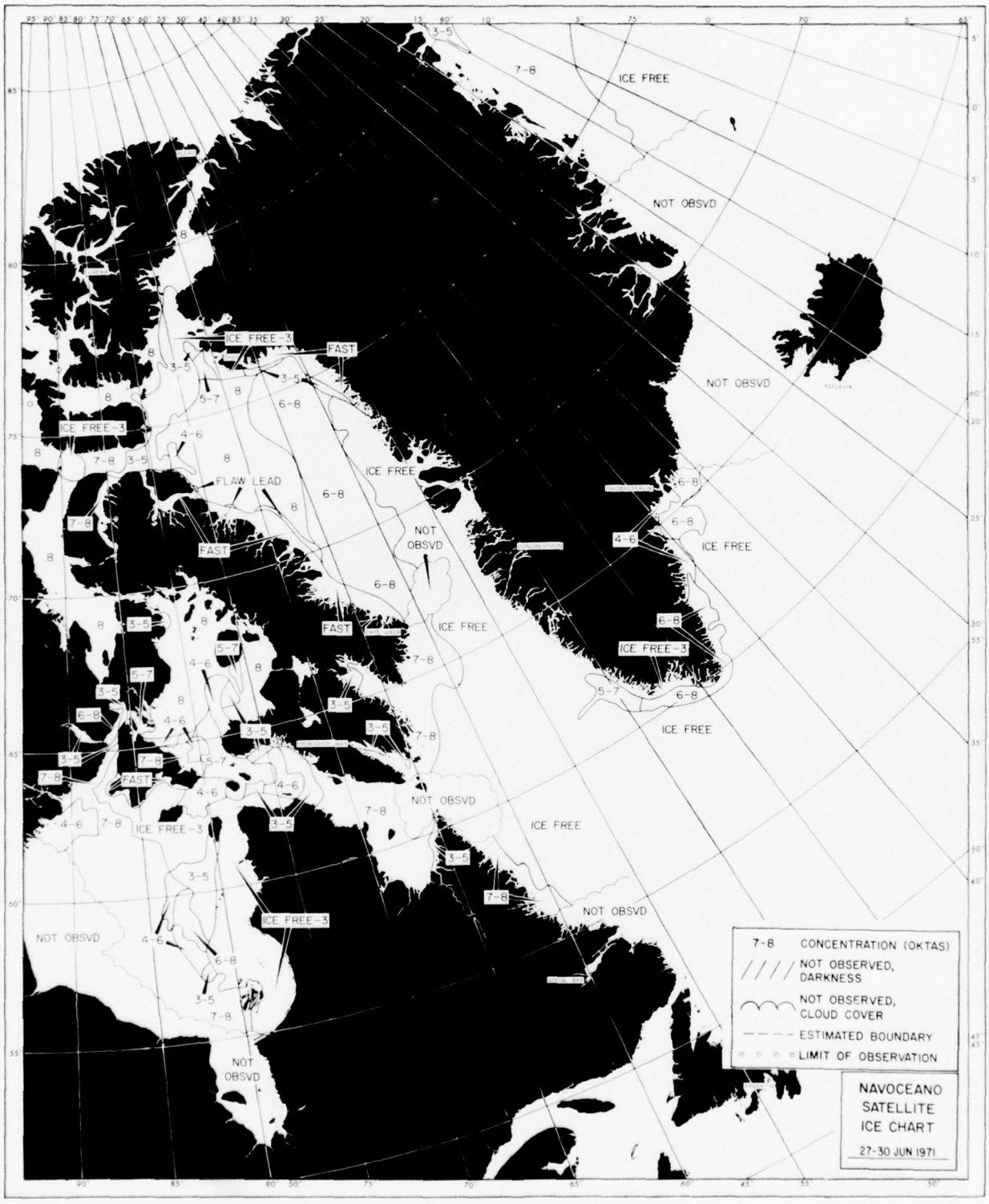
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
20-23 JUN 1971
NOT OBSVD
FAST
ICE FREE-3
5-7
NARROW DISCONTINUOUS FLAW LEAD
3-5
7-8
6-8
DISCONTINUOUS FLAW LEAD
NUMEROUS GIANT FLOES VISIBLE
ICE FREE
4-6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ICE FREE-3
FAST
FLAW LEAD
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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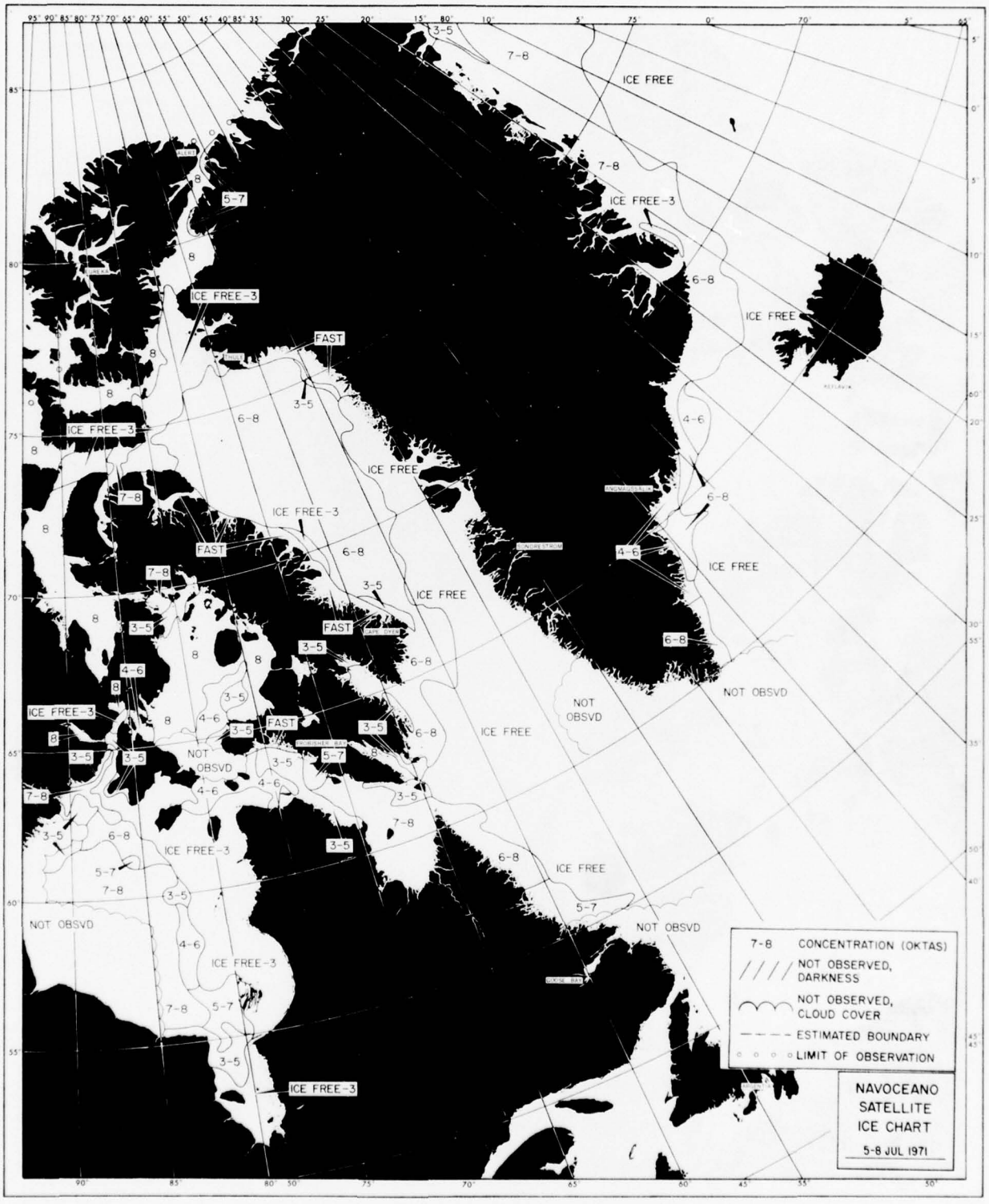
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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FAST
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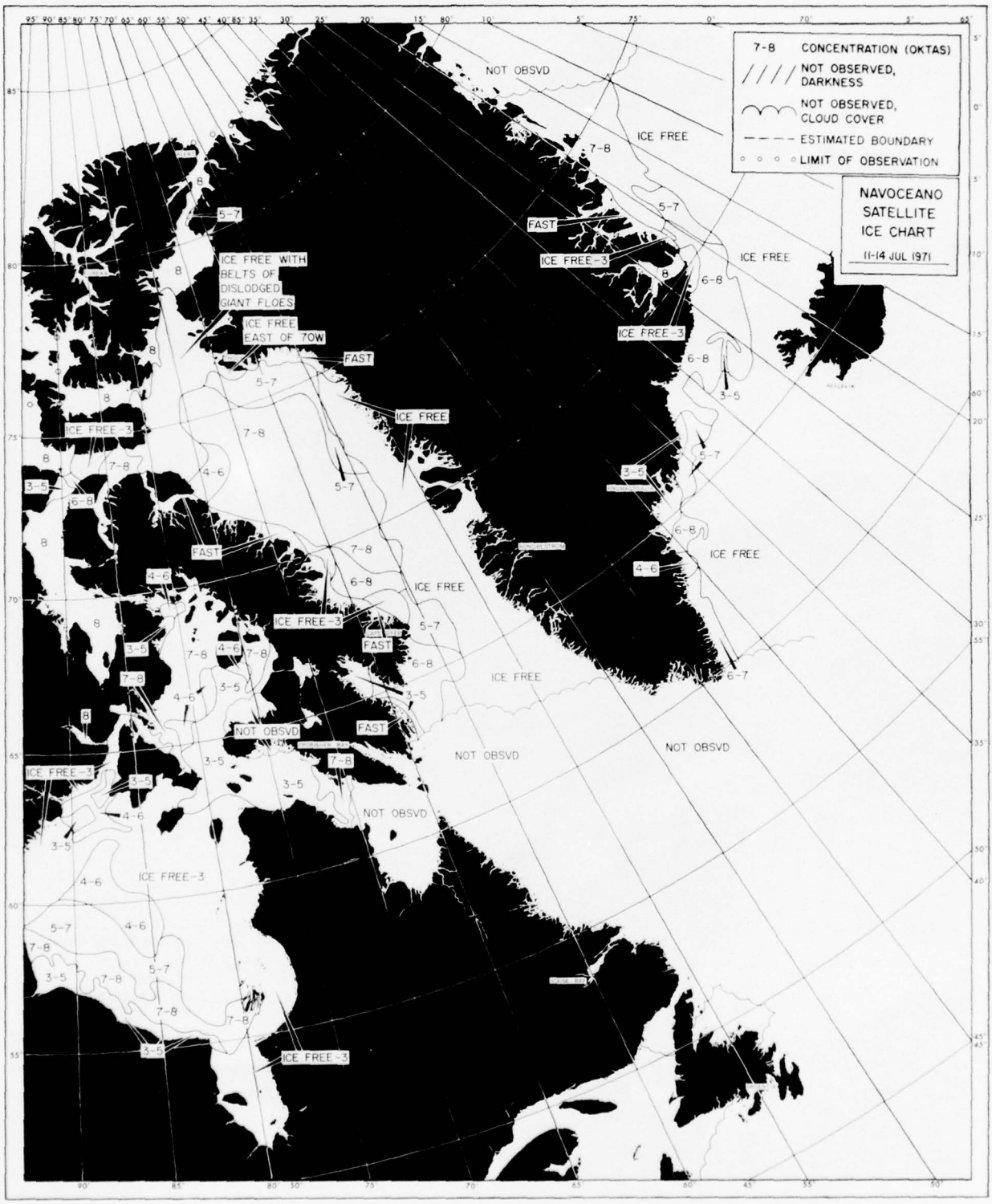
4-6
5-7
6-8
7-8
8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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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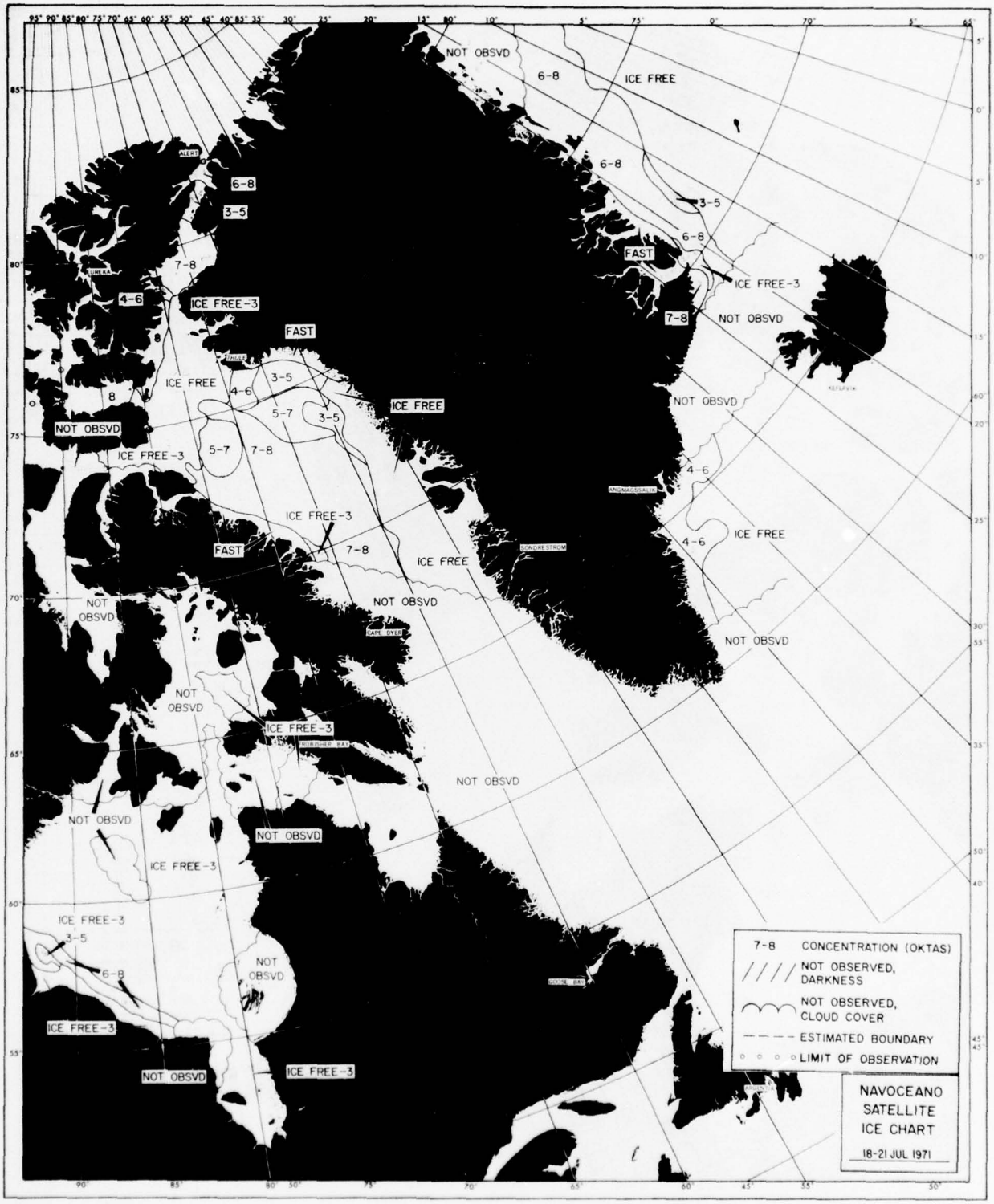
11-14 JUL 1971
NOT OBSVD
ICE FREE
FAST
ICE FREE WITH BELTS OF DISLODGED GIANT FLOES
ICE FREE EAST OF 70W
ICE FREE-3
5-7
6-8
7-8
4-6
3-5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6-8
ICE FREE
6-8
3-5
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FAST
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7-8
NOT OBSVD
ALERT
EUREKA
6-8
3-5
7-8
4-6
ICE FREE-3
FAST
THULE
ICE FREE
3-5
4-6
5-7
3-5
ICE FREE
NOT OBSVD
8
NOT OBSVD
ICE FREE-3
5-7
7-8
4-6
ANGMAGSSALIK
ICE FREE-3
FAST
7-8
ICE FREE
DANMARKSHAVN
4-6
ICE FREE
NOT OBSVD
NOT OBSVD
CAPE DYER
NOT OBSVD
NOT OBSVD
ICE FREE-3
FROBISHER BAY
NOT OBSVD
NOT OBSVD
NOT OBSVD
ICE FREE-3
ICE FREE-3
3-5
6-8
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ICE FREE-3
NOT OBSVD
ICE FREE-3
GODTHAB
7-8 CONCENTRATION (OKTAS)
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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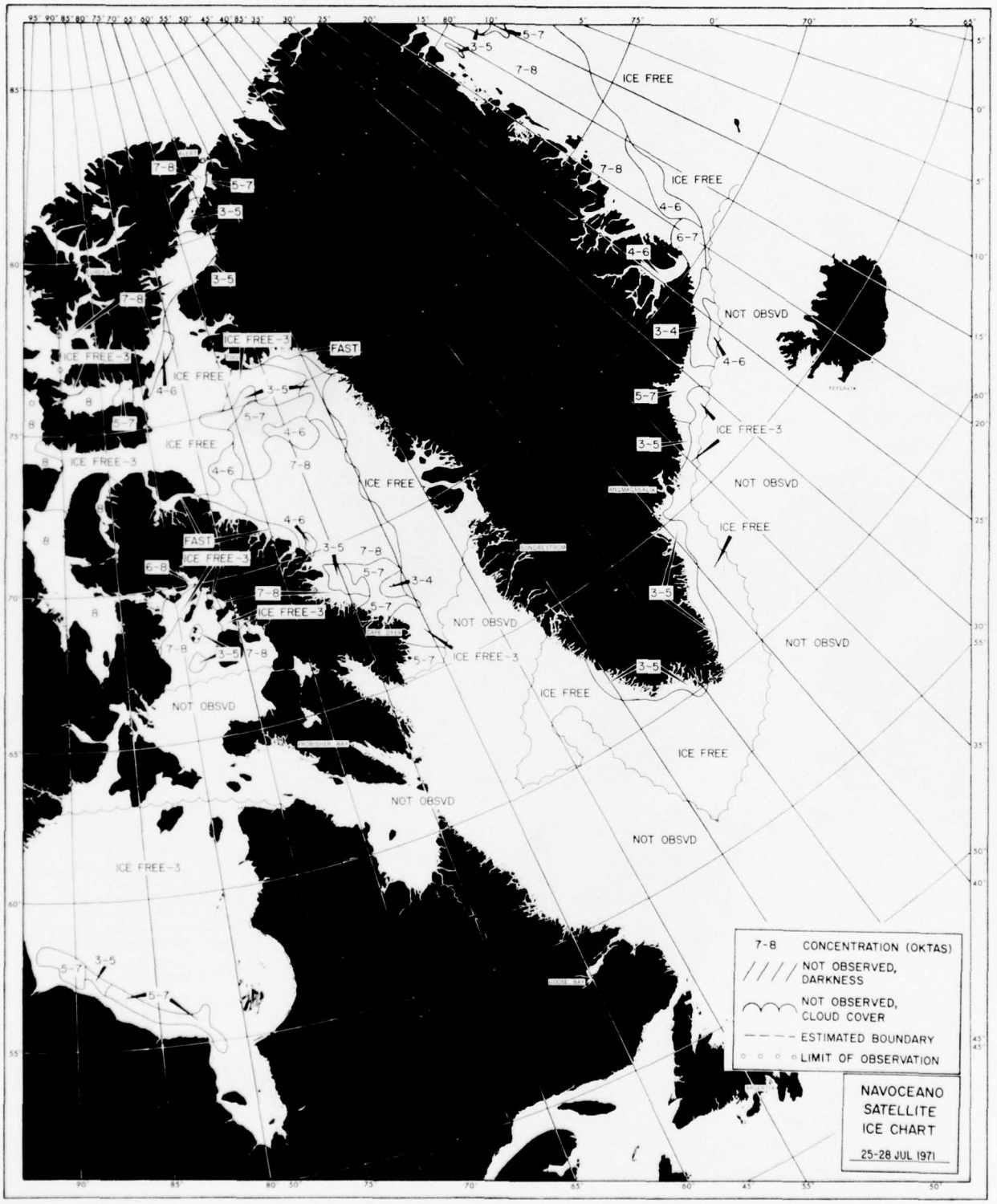
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FAST
ICE FREE-3
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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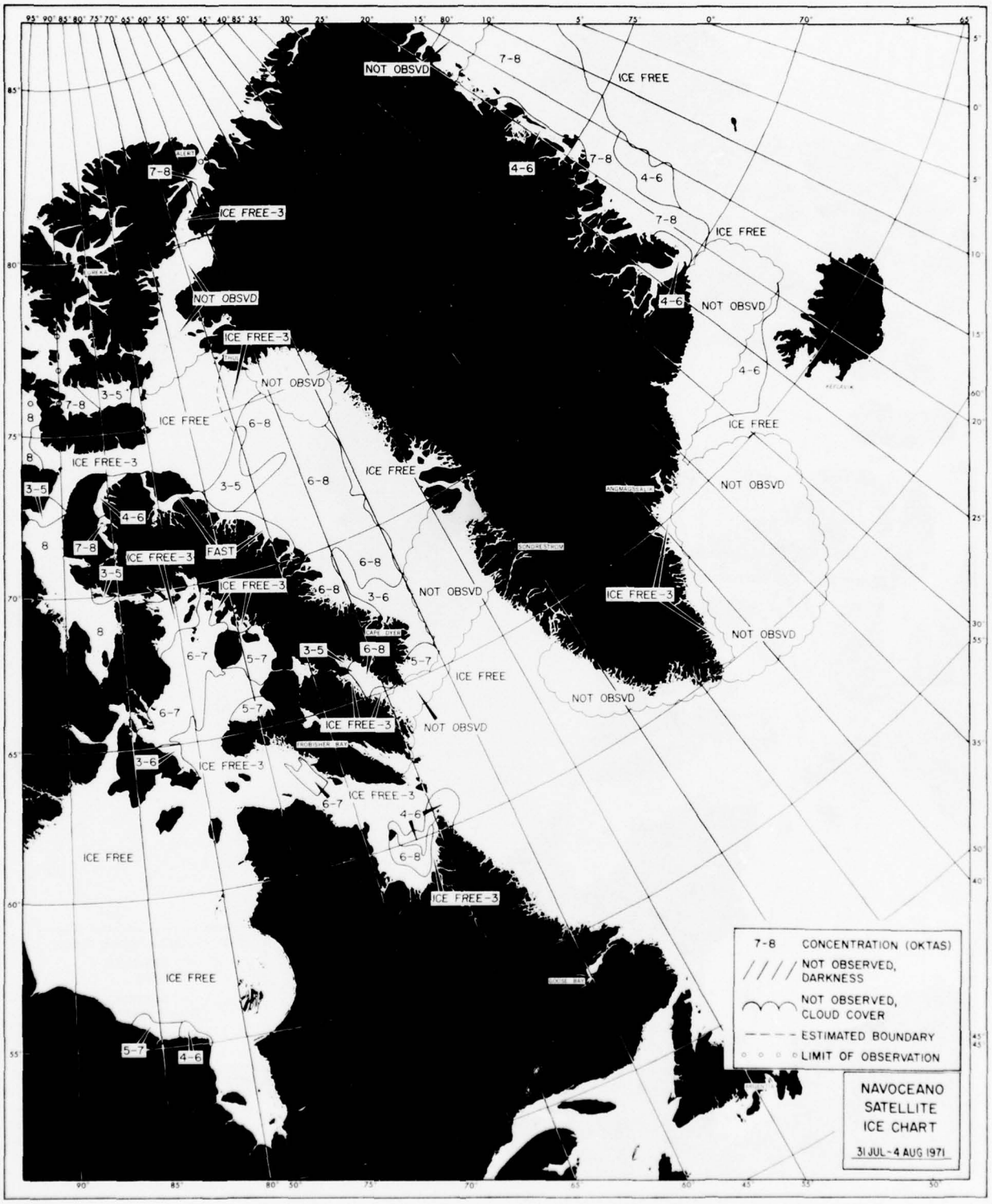
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ICE FREE
4-6
ICE FREE-3
3-5
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FAST
6-7
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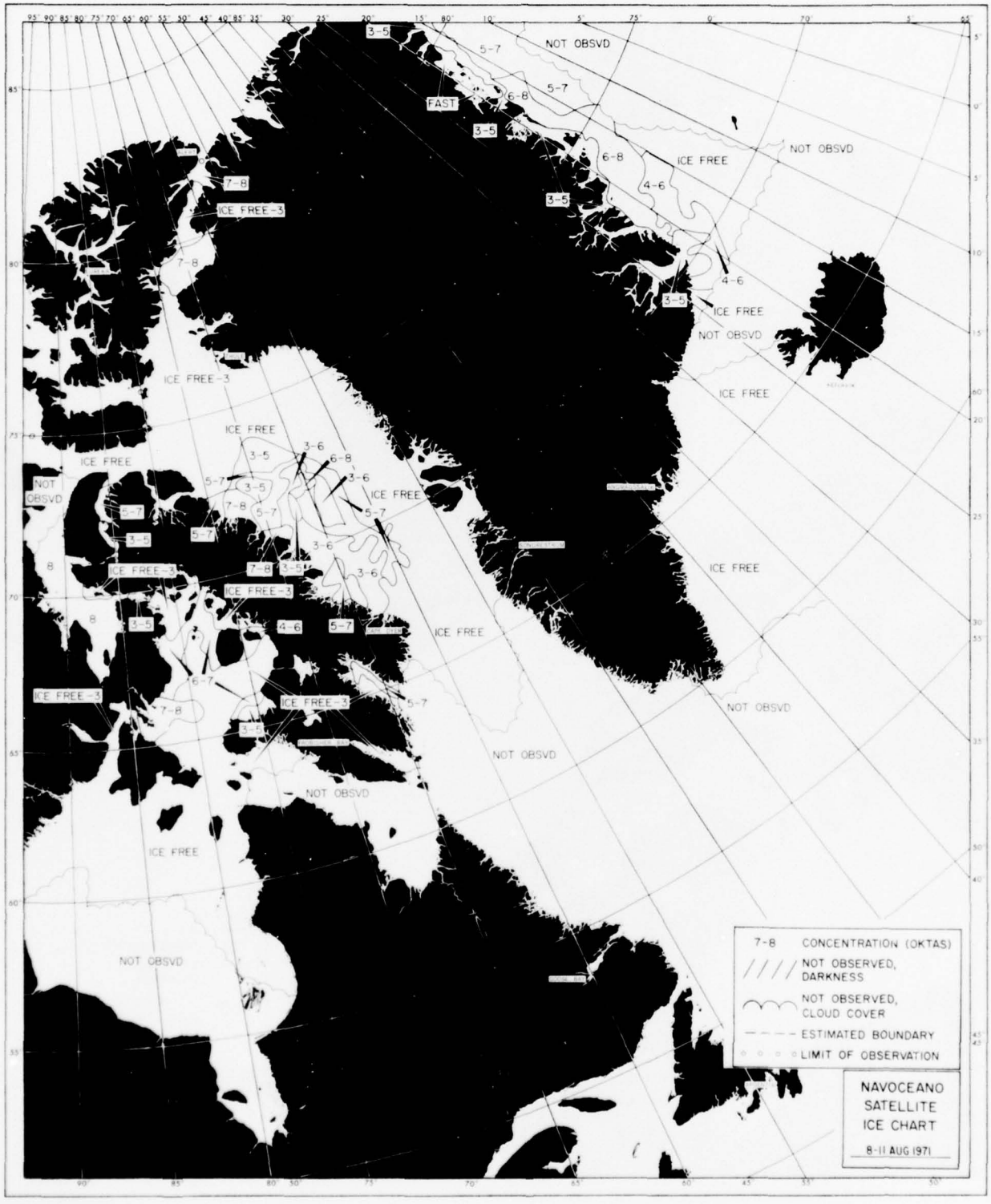
3-6
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
31 JUL - 4 AUG 1971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FAST
ICE FREE
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7-8 CONCENTRATION (OKTAS)
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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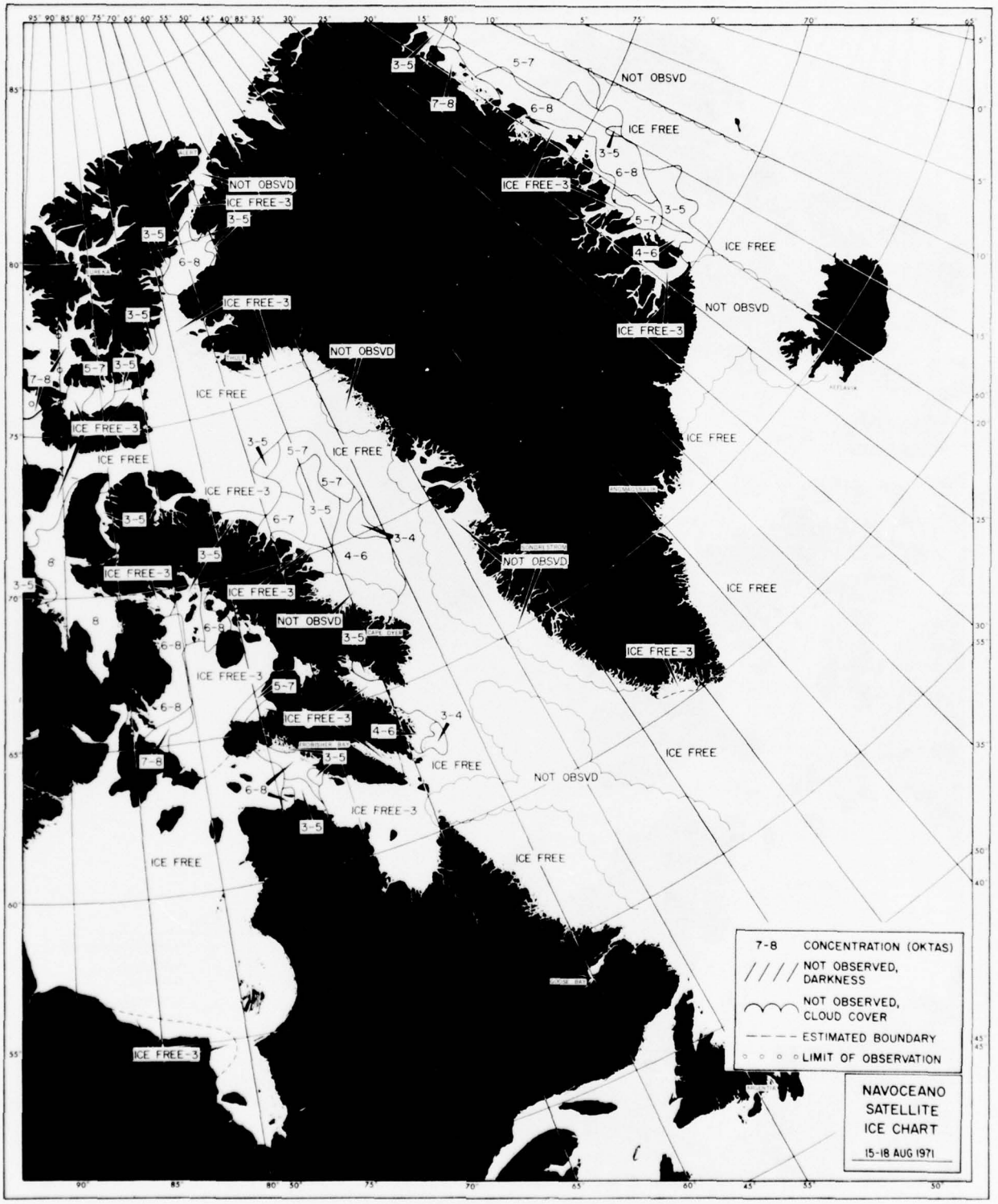
8-11 AUG 1971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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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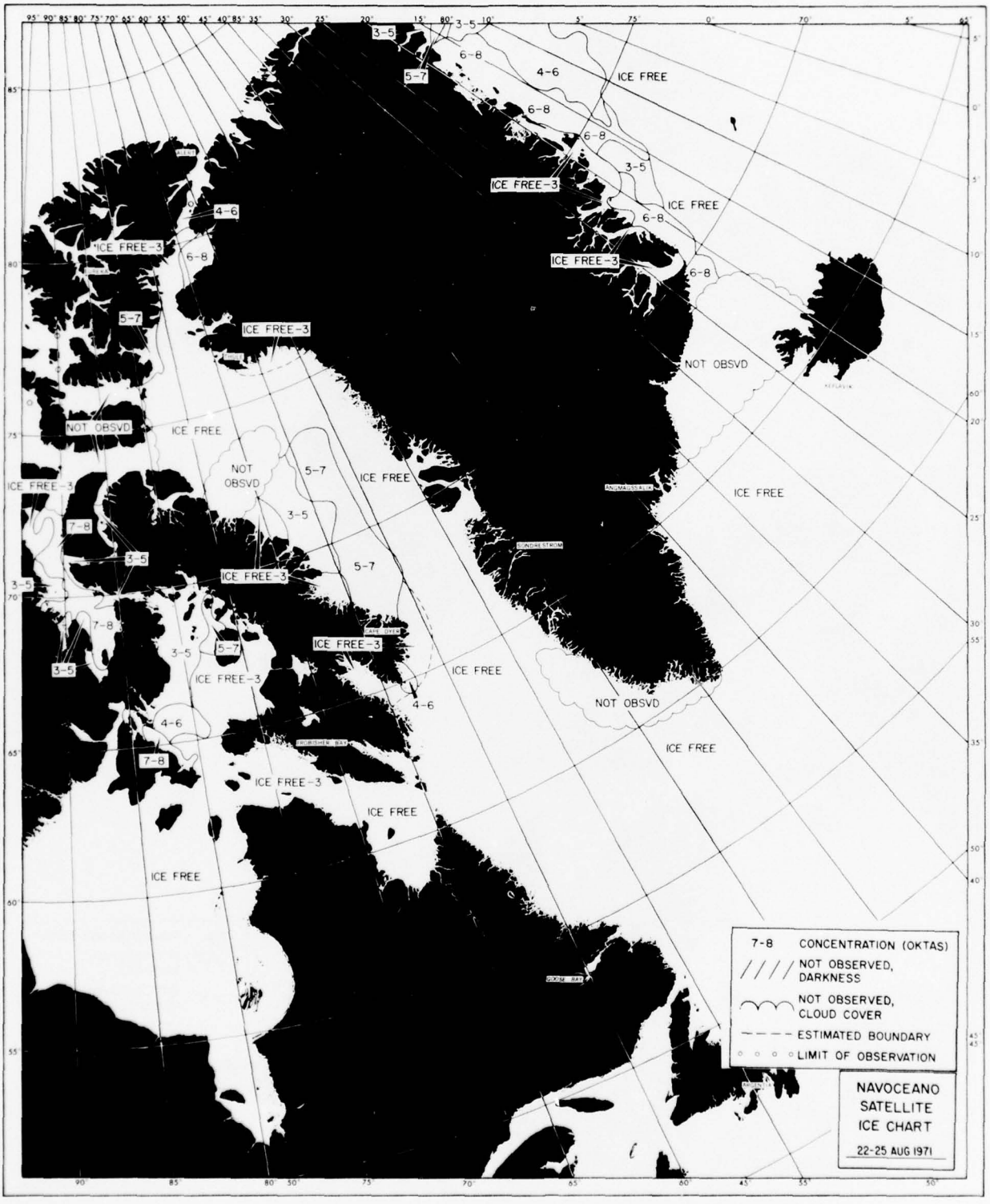
15-18 AUG 1971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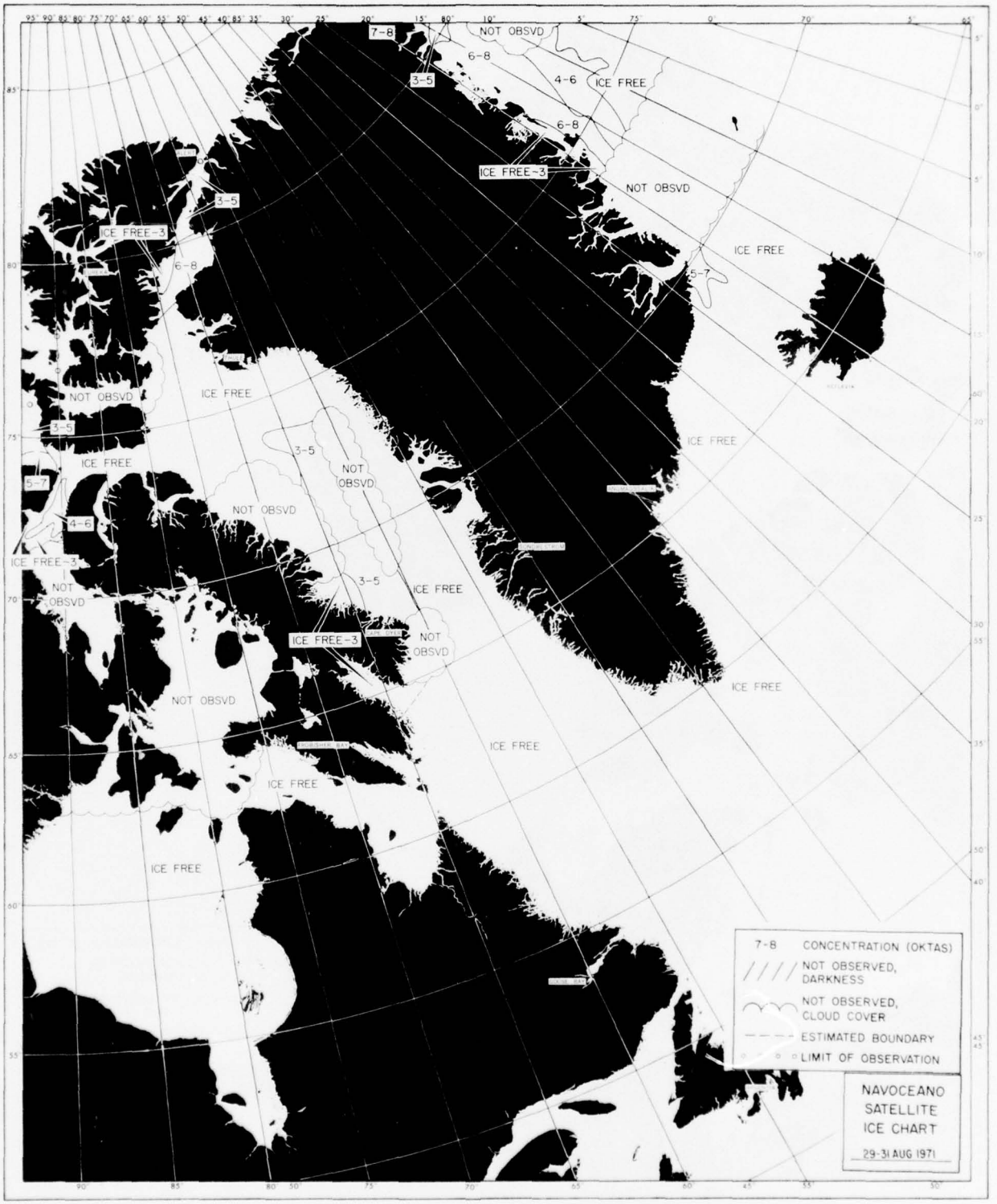
NOT
OBSVD
7-8
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO
SATELLITE
ICE CHART
22-25 AUG 1971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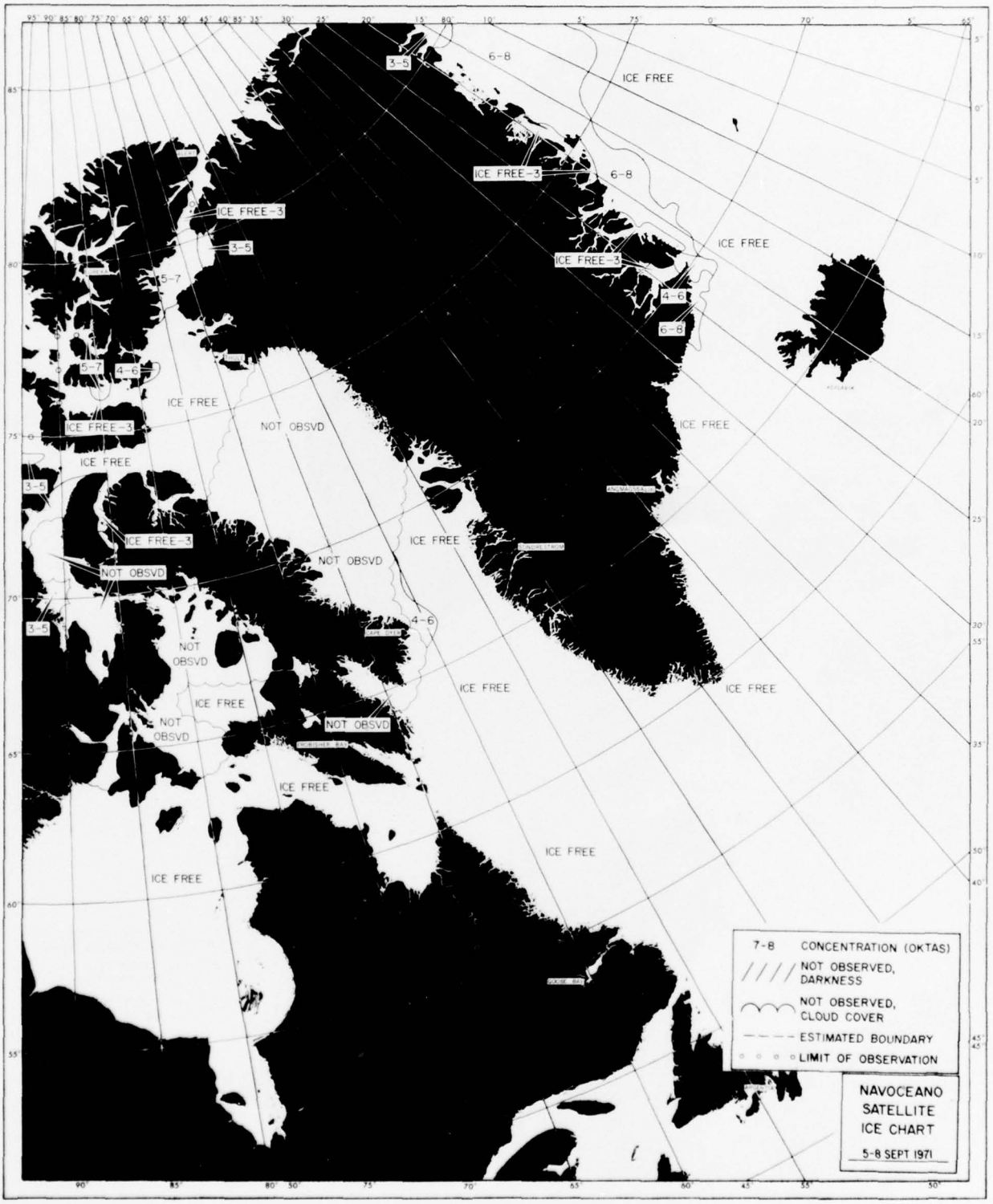
ICE FREE-3
3-5
ICE FREE
NOT
OBSVD
ICE FREE-3
NOT
OBSVD
NOT OBSVD
ICE FREE
ICE FREE
ICE FREE
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
29-31 AUG 1971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NOT OBSVD
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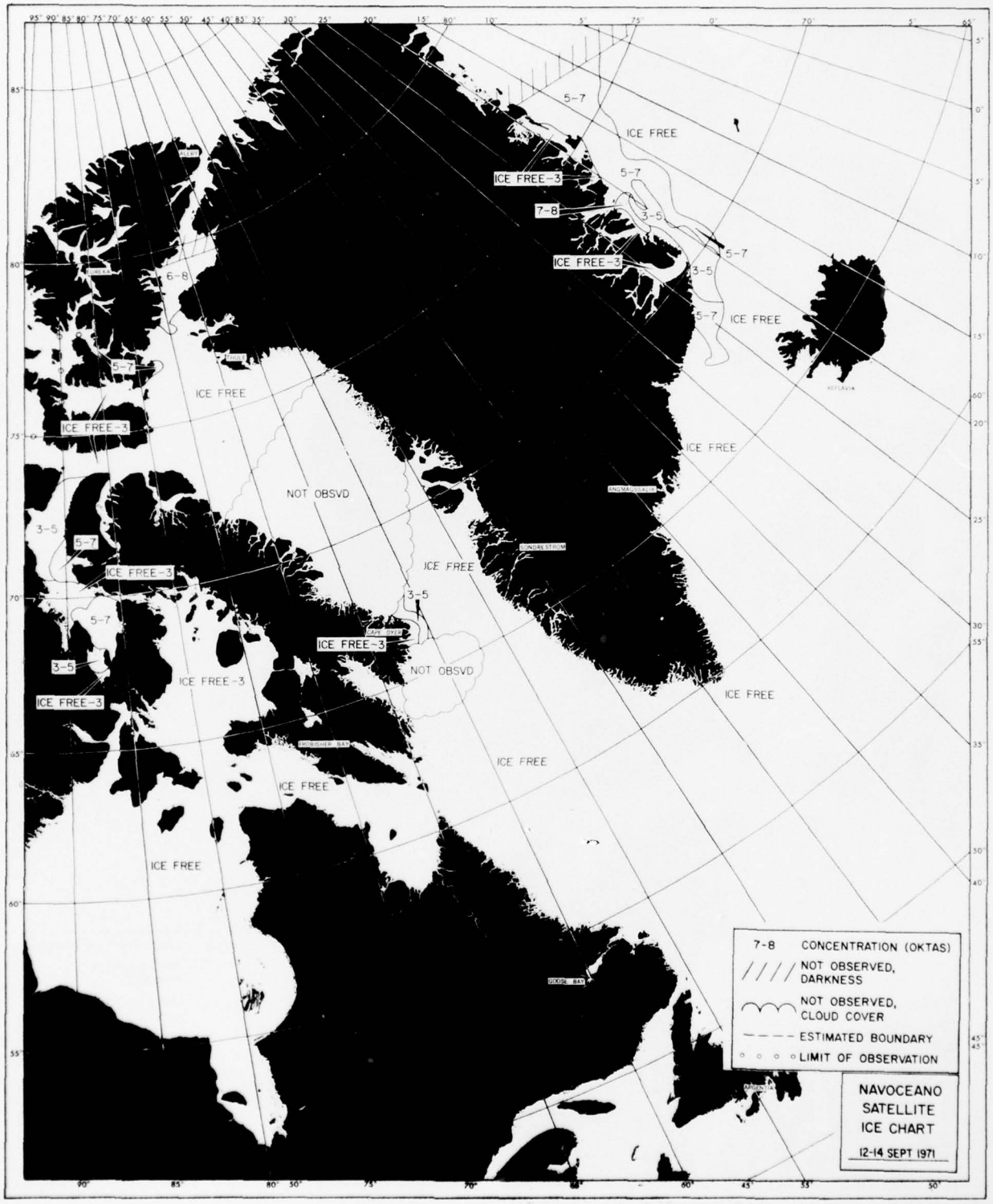
NOT OBSVD
ICE FREE
ICE FREE
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO
SATELLITE
ICE CHART
5-8 SEPT 1971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3-5
ICE FREE-3
ICE FREE-3
ICE FREE
ICE FREE
ICE FREE
ICE FREE
7-8 CONCENTRATION (OKTAS)
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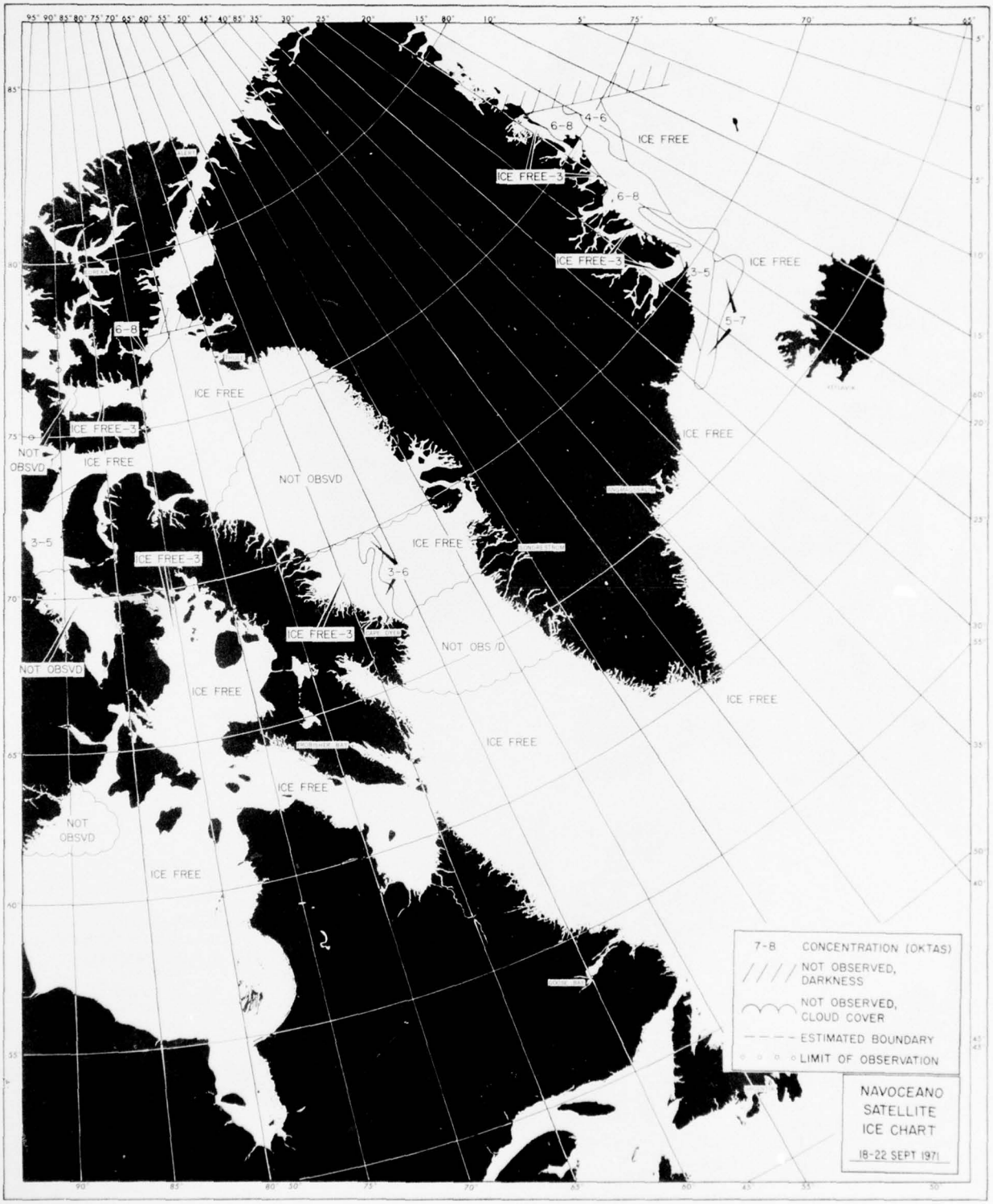
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
12-14 SEPT 1971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NOT OBSVD
ICE FREE
NOT OBSVD
ICE FREE
3-5
ICE FREE-3
3-6
ICE FREE-3
NOT OBS /D
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ICE FREE
ICE FREE
ICE FREE
NOT OBSVD
ICE FREE
7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
18-22 SEPT 1971

APPENDIX C

WESTERN ARCTIC AERIAL

RECONNAISSANCE ICE CHARTS

KEY TO ICE SYMBOLS USED IN PLOTTING ICE FEATURES

TOTAL CONCENTRATION

- Ice free
- <1 okta* (open water)
- 1-<3 oktas (very open pack)
- 3-<6 oktas (open pack)
- 6-<7 oktas (close pack)
- 7-<8 oktas (very close pack)
- 8 oktas (compact pack)

CONC = Concentration
CRK = Crack
CRKS = Cracks
FRCT = Fracture
FRCTV = Very Small Fracture
FRCTS = Small Fracture
FRCTM = Medium Fracture
FRCTL = Large Fracture
LVL = Level Ice
NDTR = Not Determined
NOPG = No Openings in Ice
OPWR = Open Water
SCTD = Scattered
SD = Snow Depth
T = Ice Thickness

COVERAGE BY SIZE

$$\frac{C}{n_1 n_2 n_3}$$

C = total concentration

n_1
- SS/NL = New Ice or Nilas
- PK = Pancake <3 m
- CK = Brash, Small Cake, Cake <20 m

n_2
- SF = Small Floe 20—100 m
- MF = Medium Floe 100—500 m

n_3
- BF = Big Floe 500—2000 m
- VF = Vast Floe 2—10 km
- GF = Giant Floe >10 km
- Fast = Fast Ice

Example: $\frac{7}{124}$ PK
- 7 = total concentration
- 1 = okta all pancake ice
- 2 = oktas small and medium ice floes
- 4 = oktas big, vast, and giant ice floes

STAGE OF DEVELOPMENT

$$\frac{A}{\text{oktas predominant, oktas secondary}}$$

AGE

SS = Frazil, Grease, Slush, Shuga
NL = Ice Rind, Dark Nilas, Light Nilas
G = Gray
GW = Gray-White
FL = Thin First-Year
FM = Medium First-Year
FT = Thick First-Year
SY = Second-Year
MY = Multi-Year

AVERAGE THICKNESS

- NL: <5—10 cm
- G: 10—15 cm
- GW: 15—30 cm
- FL: 30—70 cm
- FM: 70—120 cm
- FT: >120 cm

Example: $\frac{A}{5FM3G}$
- A = Stage of development
- 5FM = 5 oktas Medium First-Year
- 3G = 3 oktas Gray

*One okta equals one-eighth ice concentration

TOPOGRAPHY

- Rafted or Finger-Rafted Ice
- Hummocks
- (N) New Ridges
- (W) Weathered Ridges
- (V) Very Weathered Ridges
- (A) Aged Ridges
- (C) Consolidated Ridges

Example: $\frac{\text{(N) (h)}}{\text{(n)}}$

(h) height of ridges in meters
(n) tenths coverage on ice

STAGE OF MELTING

FPD = Few Puddles
MPD = Many Puddles
FTH = Few Thaw Holes
MTH = Many Thaw Holes
DRI = Dried Ice
ROT = Rotten Ice
FLO = Flooded Ice

UNDERCAST

Limit

THICKNESS OF ICE & SNOW

t_E = ice thickness in cm
s = snow depth in cm

PHENOMENA

- crack
- fracture
- polynya
- lead
- (n) icebergs
- (n) bergy bits & growlers

(n) = number in area

ICE EDGE

- observed
- radar
- limit of observed data
- satellite data

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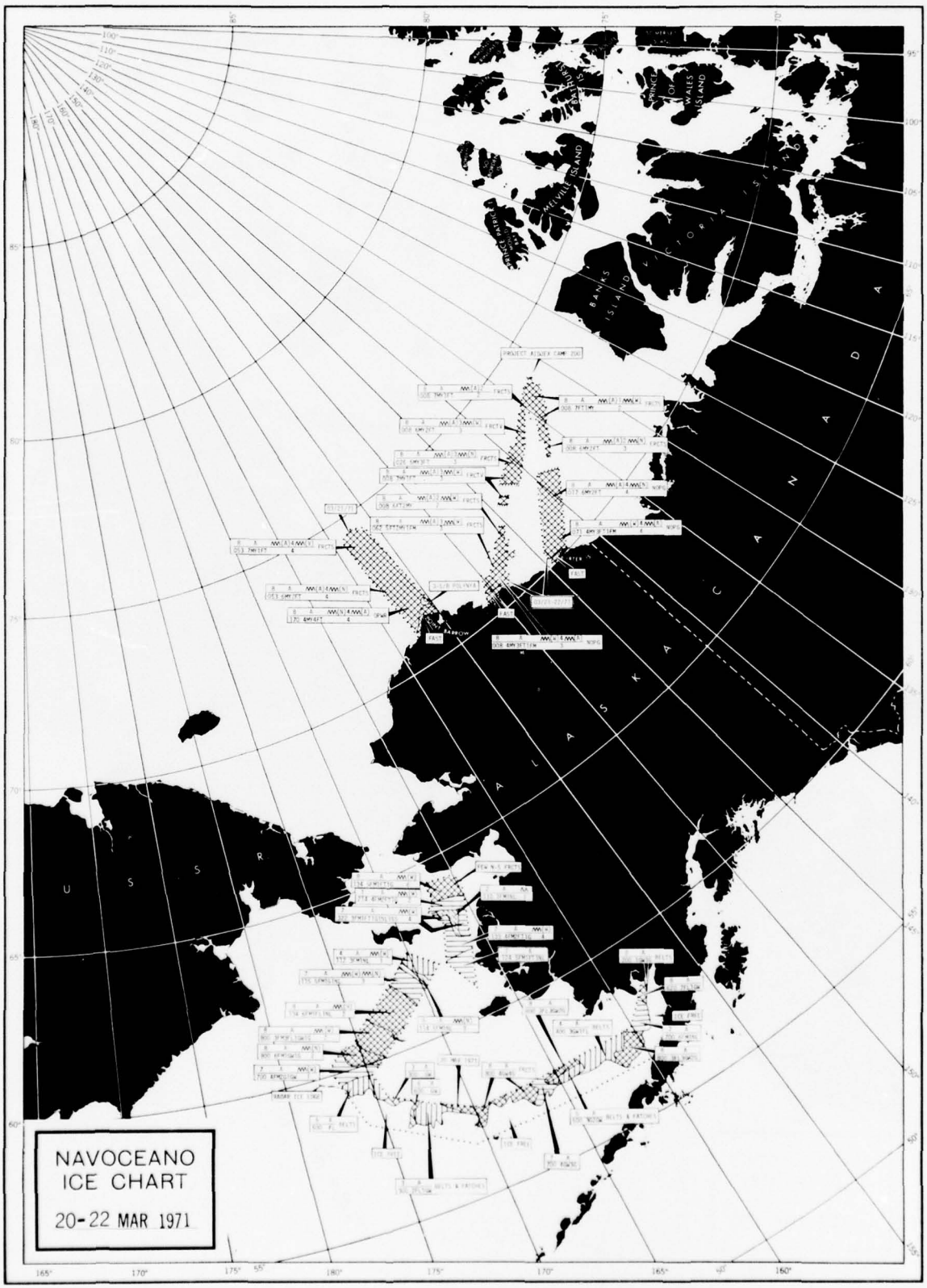
(For convenience, use fold out Key to Ice Symbols on page 12.)


NAVOCEANO
ICE CHART
12–18 JAN 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARTER IS.


NAVOCEANO
ICE CHART
26 FEB 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
MELVILLE ISLAND
BARTER IS
POINT BARROW


NAVOCEANO
ICE CHART
9 MAR 1971
U. S. S. R.
A L A S K A
C A N A D A
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
BARTER IS
POINT BARROW


NAVOCEANO
ICE CHART
18–19 MAR 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
POINT BARROW
BARTER IS.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20-22 MAR 1971
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C A N A D A
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MELVILLE ISLAND
PRINCE OF WALES ISLAND
BARROW


NAVOCEANO
ICE CHART
23-24 MAR 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
MELVILLE ISLAND
BARROW


NAVOCEANO
ICE CHART
6 APR 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND


NAVOCEANO
ICE CHART
15 APR 1971
U S S R
A L A S K A
C A N A D A
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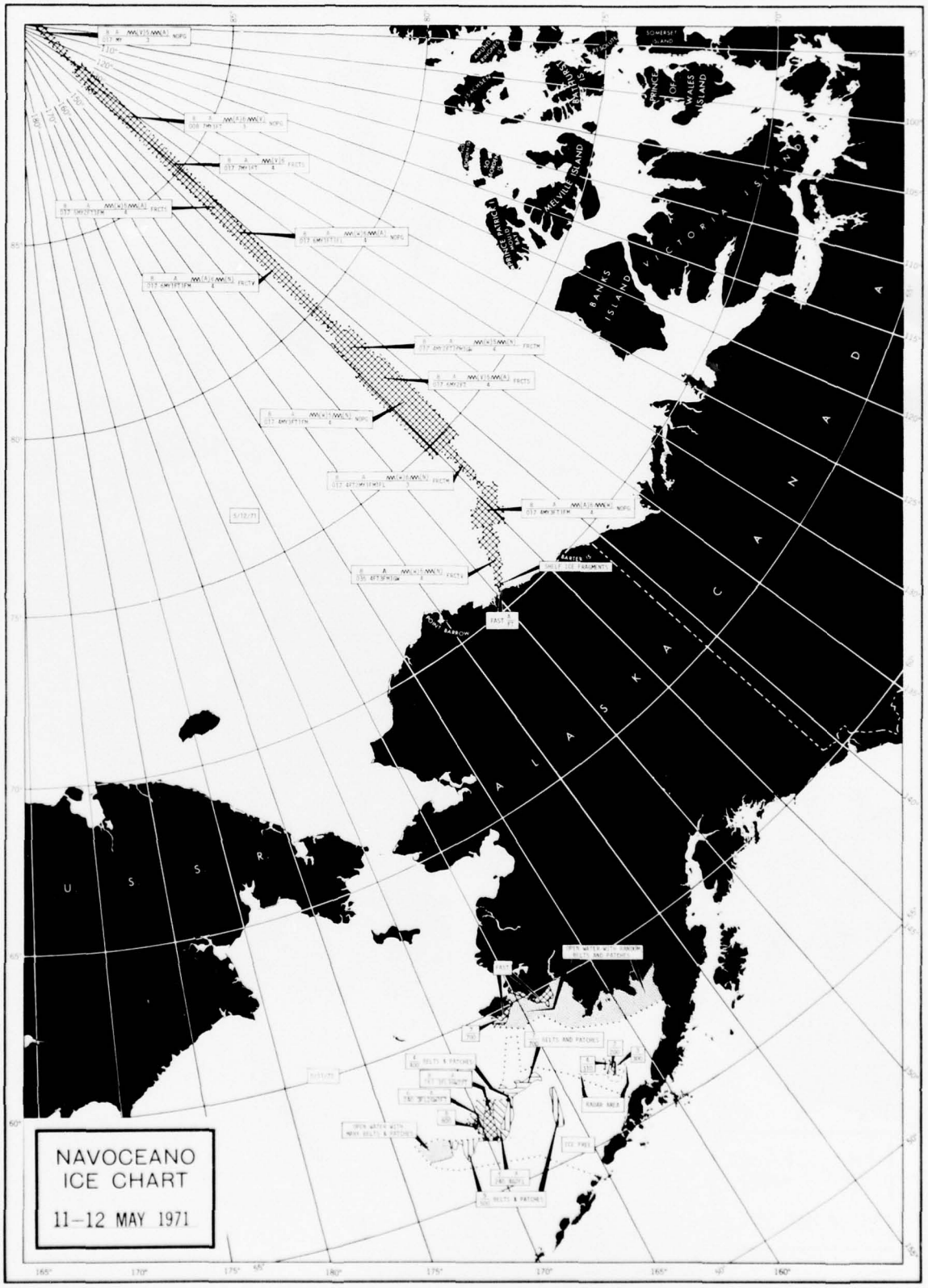
VICTORIA ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
MELVILLE ISLAND
BARTER IS.
POINT BARROW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11–12 MAY 1971
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C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
POINT BARROW
BARTER IS.
FAST ICE
OPEN WATER WITH UNKNOWN ICE AND FLOES
FLOES AND FLOATERS
KNOWN AREA
ICE FREE
165°
170°
175°
180°
175°
170°
165°
160°


NAVOCEANO
ICE CHART
13–14 MAY 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
OPEN WATER
165°
170°
175°
180°
175°
170°
165°
160°


NAVOCEANO
ICE CHART
17-18 MAY 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
POINT BARROW
165°
170°
175°
180°
175°
170°
165°
160°


NAVOCEANO
ICE CHART
21 MAY 1971
U. S. S. R.
A L A S K A
C A N A D A
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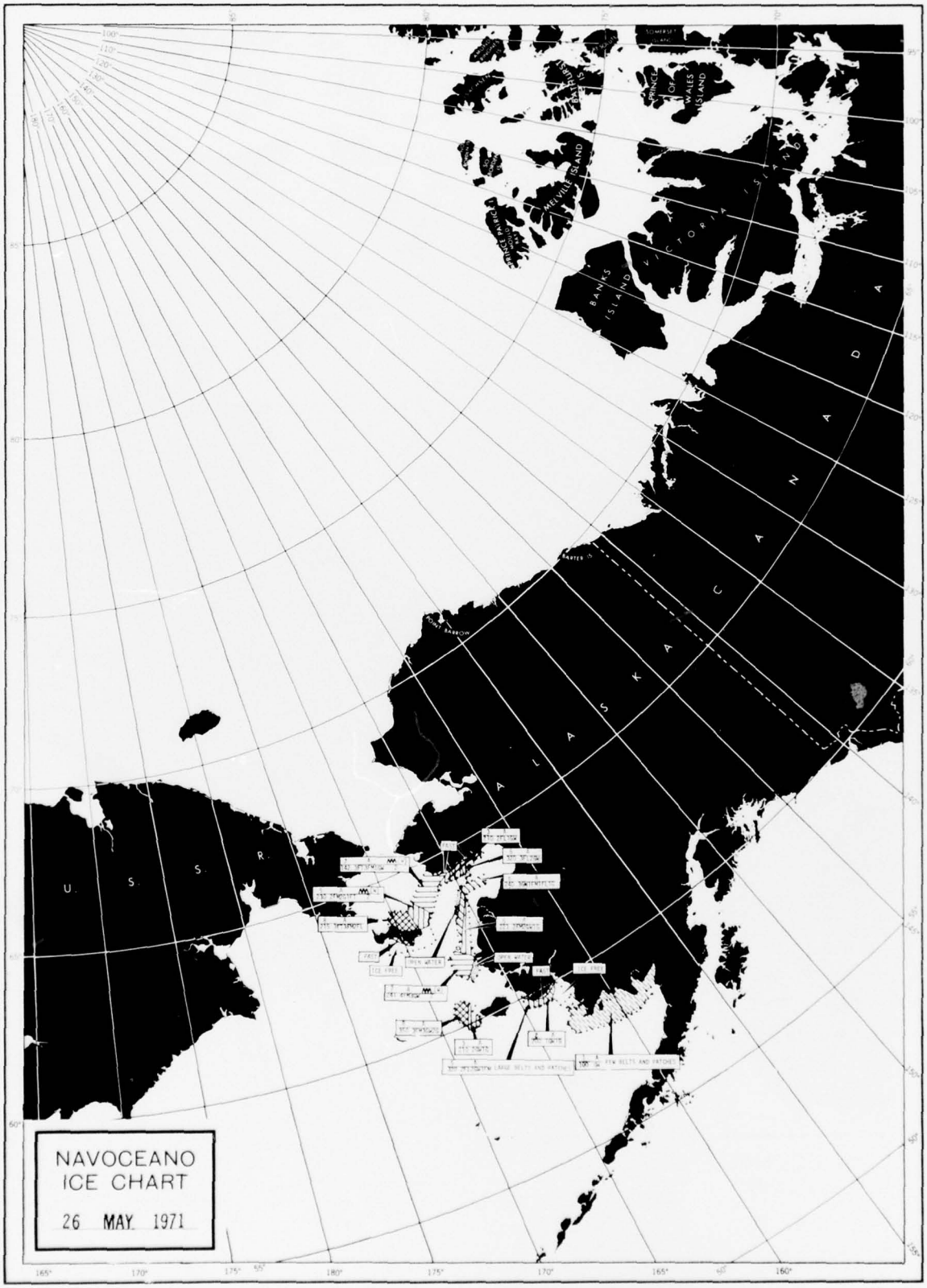
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARTER IS
POINT BARROW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ICE CHART
26 MAY 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BARTER I.
POINT BARROW


NAVOCEANO
ICE CHART
6 JUNE 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BARROW


NAVOCEANO
ICE CHART
9 JUNE 1971
U. S. S. R.
A L A S K A
C A N A D A
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARROW


SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
PRINCE PATRICK ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U S S R
NAVOCEANO
ICE CHART
1 JULY 1971


NAVOCEANO
ICE CHART
16 JULY 1971
U S S R
A L A S K A
C A N A D A
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
PRINCE PATRICK ISLAND
OPEN WATER
ICE FREE
RADAR ICE EDGE


NAVOCEANO
ICE CHART
17 JULY 1971
U S S R
A L A S K A
C A N A D A
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
100°
110°
120°
130°
140°
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180°
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165°
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175°
180°
175°
170°
165°
160°


NAVOCEANO
ICE CHART
23 JULY 1971
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
MELVILLE ISLAND
OPEN WATER
ICE FREE
U S S R
A L A S K A
C A N A D A


NAVOCEANO
ICE CHART
30-31 JULY 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
OPEN WATER
RADAR ICE EDGE
ICE FREE


NAVOCEANO
ICE CHART
31 JULY 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
KING OF WALES ISLAND
SOMERSET ISLAND


NAVOCEANO
ICE CHART
3 AUG 1971
SOMERSET ISLAND
PRINCE OF WALES ISLAND
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
BARROW
U S S R
A L A S K A
C A N A D A


NAVOCEANO
ICE CHART
6 AUG 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARROW


NAVOCEANO
ICE CHART
11 AUG 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARTER IS.
BARROW


NAVOCEANO
ICE CHART
13 AUG 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
MELVILLE ISLAND
OPEN WATER
FAST ICE EDGE


SOMERSET ISLAND
PRINCE OF WALES ISLAND
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
CANADA
ALASKA
U. S. S. R.
NAVOCEANO
ICE CHART
13-14 AUG 1971


NAVOCEANO
ICE CHART
20 AUG 1971
U. S. S. R.
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARTER IS.
RADAR ICE EDGE
OPEN WATER


NAVOCEANO
ICE CHART
4-7 SEPT 1971
U. S. S. R.
A L A S K A
C A N A D A
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
POINT BARROW


NAVOCEANO
ICE CHART
1 OCT 1971
U.S.S.R.
ALASKA
CANADA
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND


NAVOCEANO
ICE CHART
29 OCT 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARTER IS


NAVOCEANO
ICE CHART
21 NOV 1971
U.S.S.R.
ALASKA
CANADA
VICTORIA ISLAND
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARTER IS
POINT BARROW


SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
BARTER I.
POINT BARROW
ALASKA
U. S. S. R.
NAVOCEANO
ICE CHART
5 DEC 1971

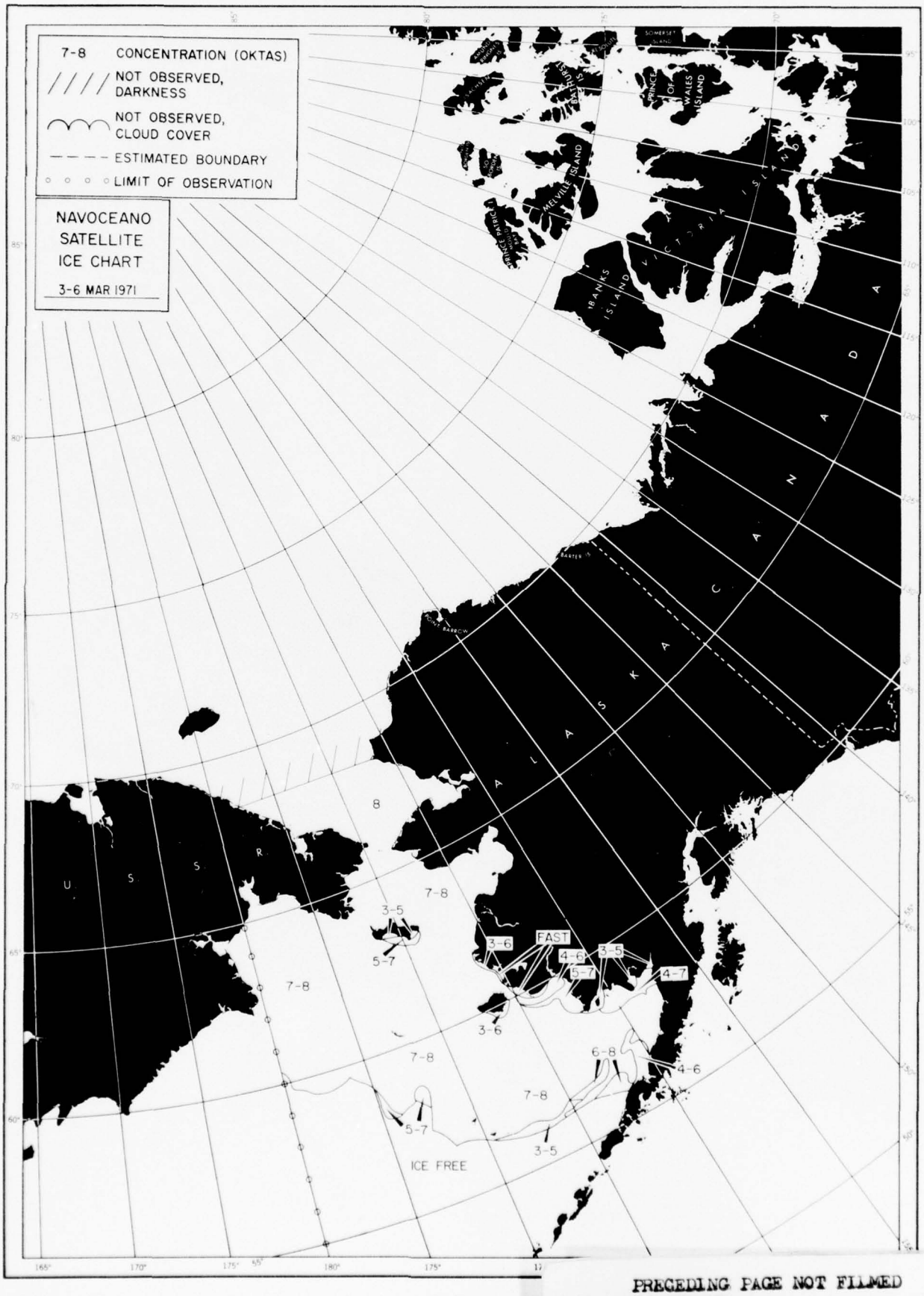

NAVOCEANO
ICE CHART
11 DEC 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BARROW
BARTER IS.


NAVOCEANO
ICE CHART
15 DEC 1971
U S S R
A L A S K A
C A N A D A
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
POINT BARROW

APPENDIX D

WESTERN ARCTIC SATELLITE

ICE CHARTS



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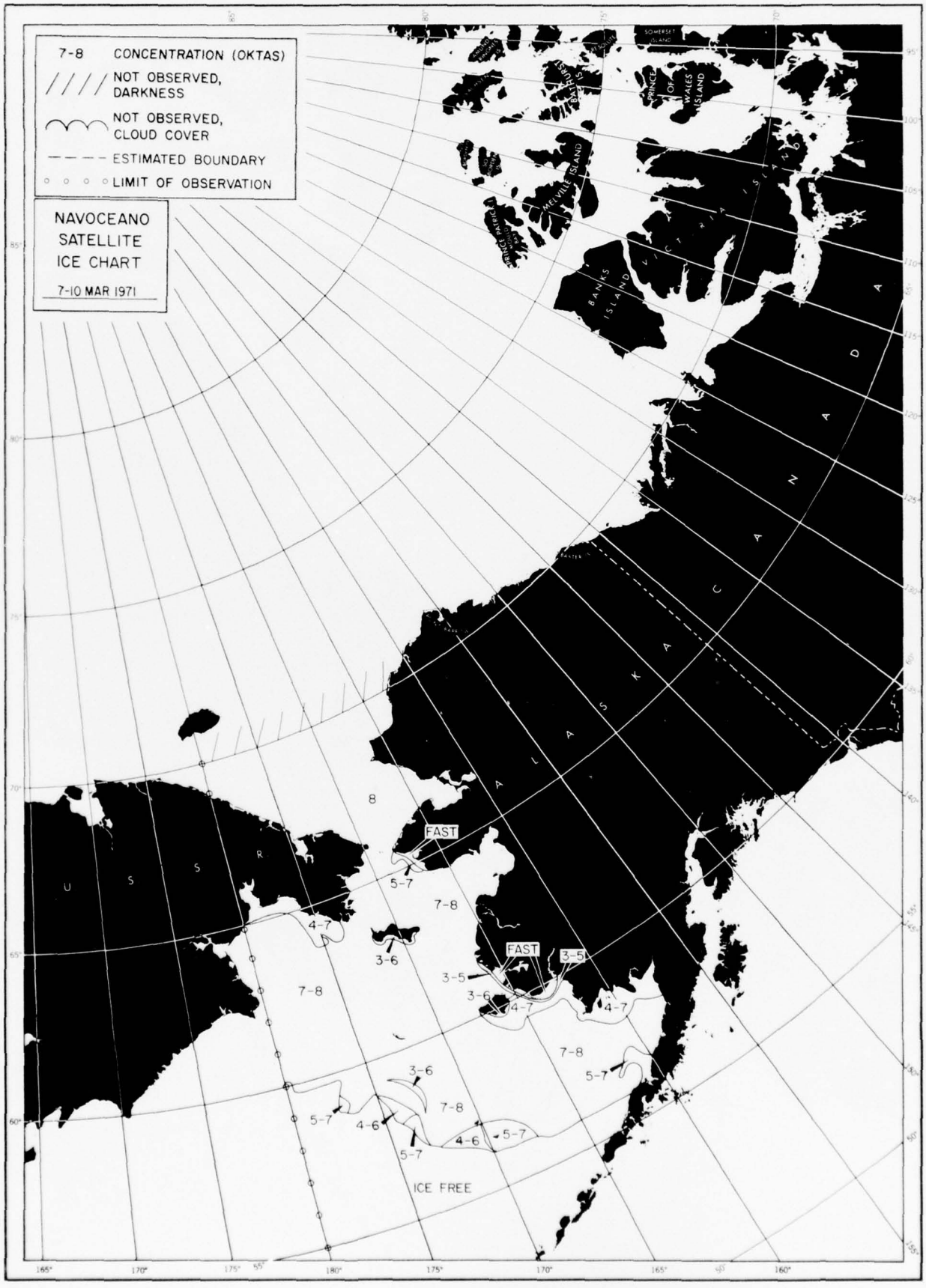
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
7-10 MAR 1971
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
CANADA
ALASKA
U S S R
FAST
FAST
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ICE FREE
85°
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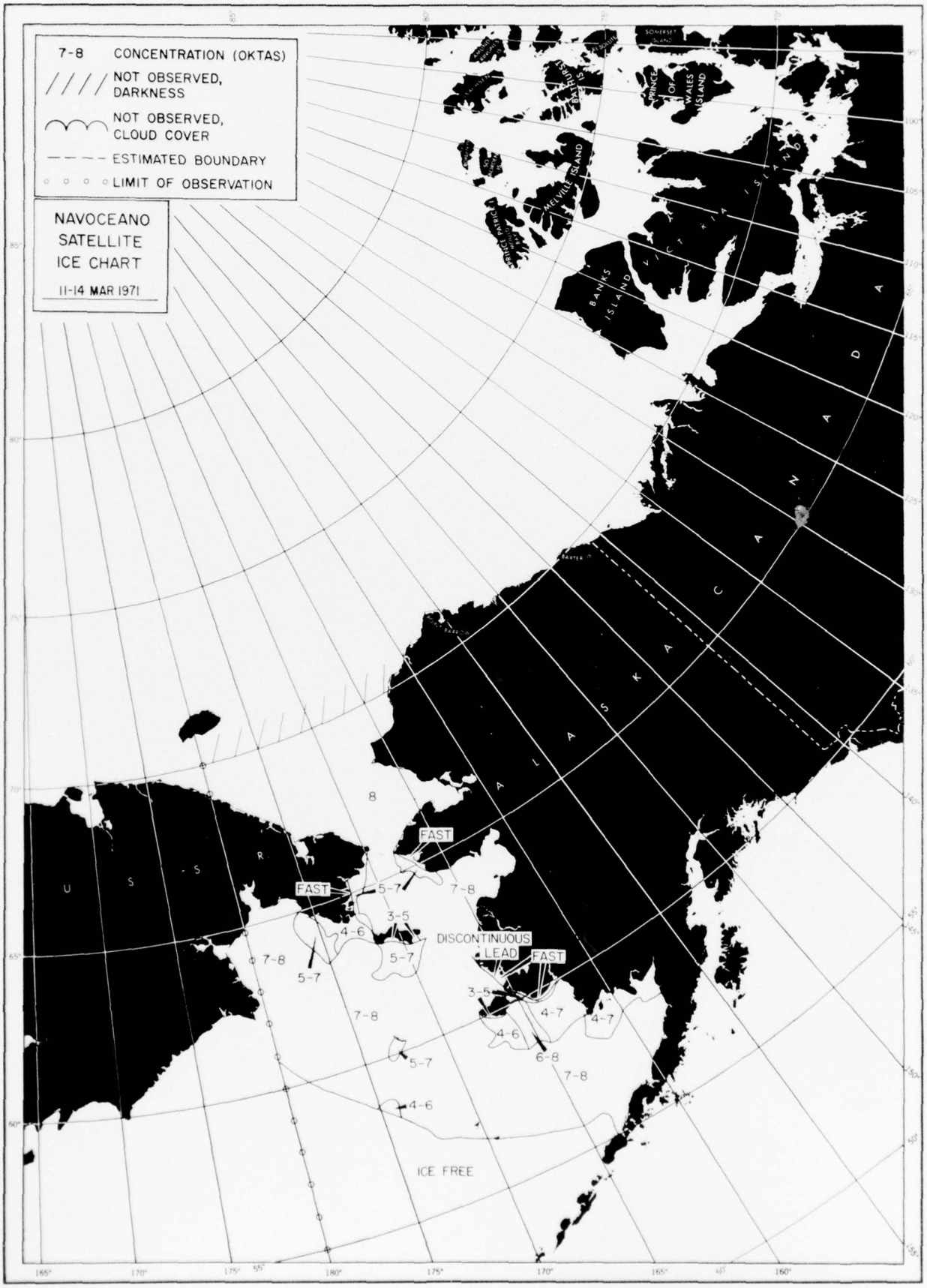
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
11-14 MAR 1971
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
FAST
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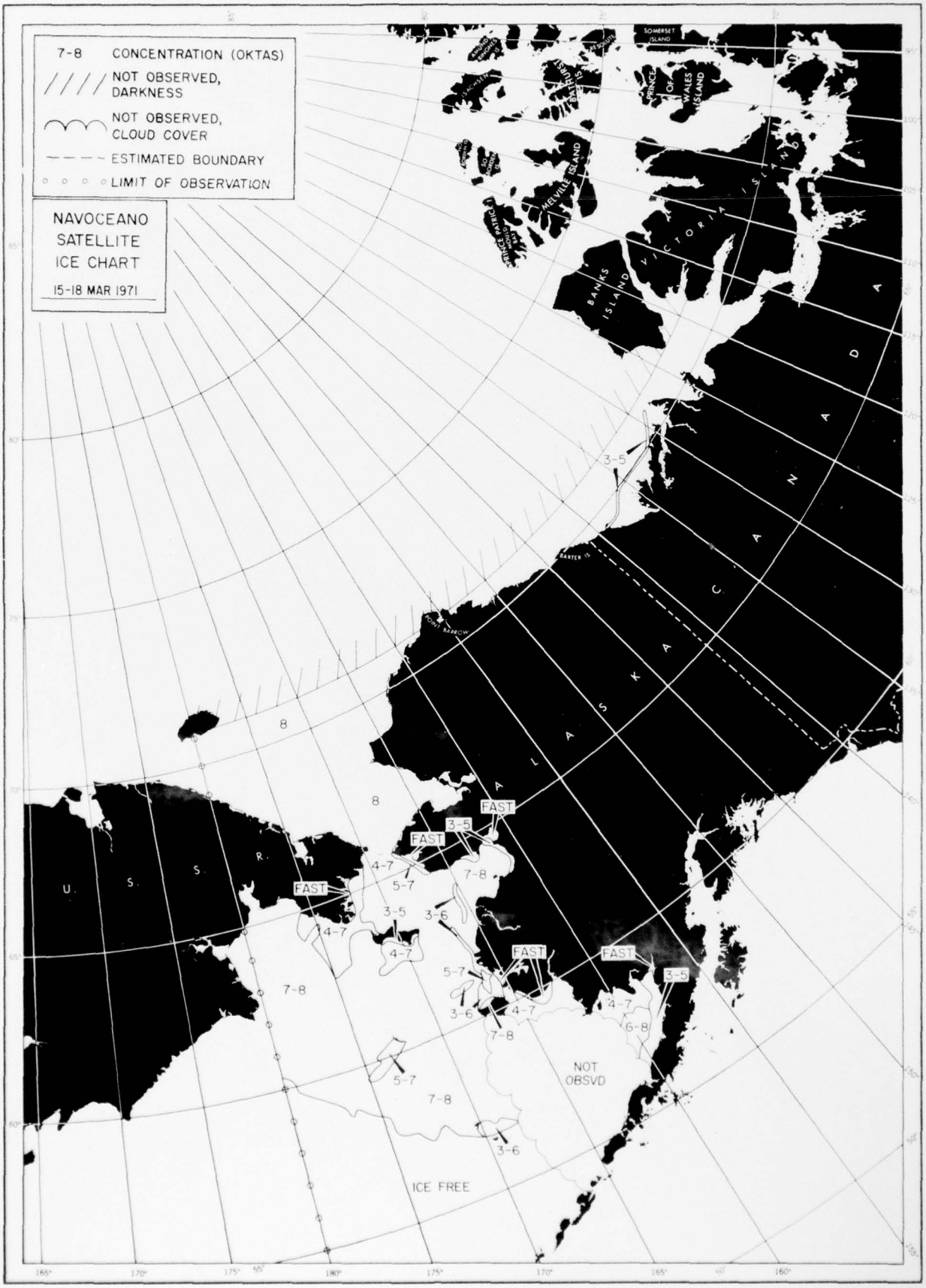
7-8
3-5
4-6
DISCONTINUOUS LEAD
4-7
6-8
8
ICE FREE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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
15-18 MAR 1971
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U. S. S. R.
BARTER IS
POINT BARROW
FAST
3-5
4-7
5-7
7-8
3-6
6-8
8
NOT OBSVD
ICE FREE
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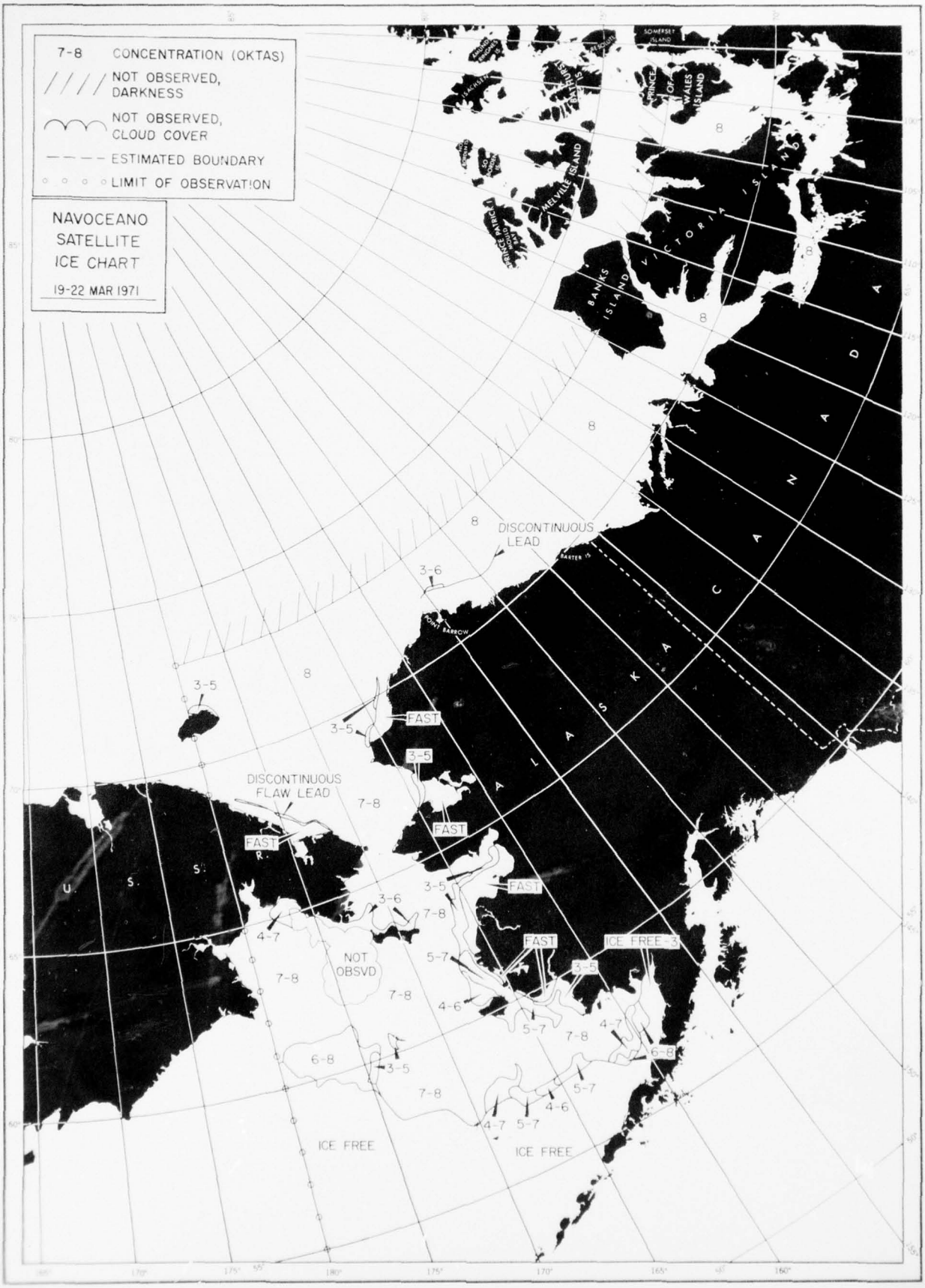
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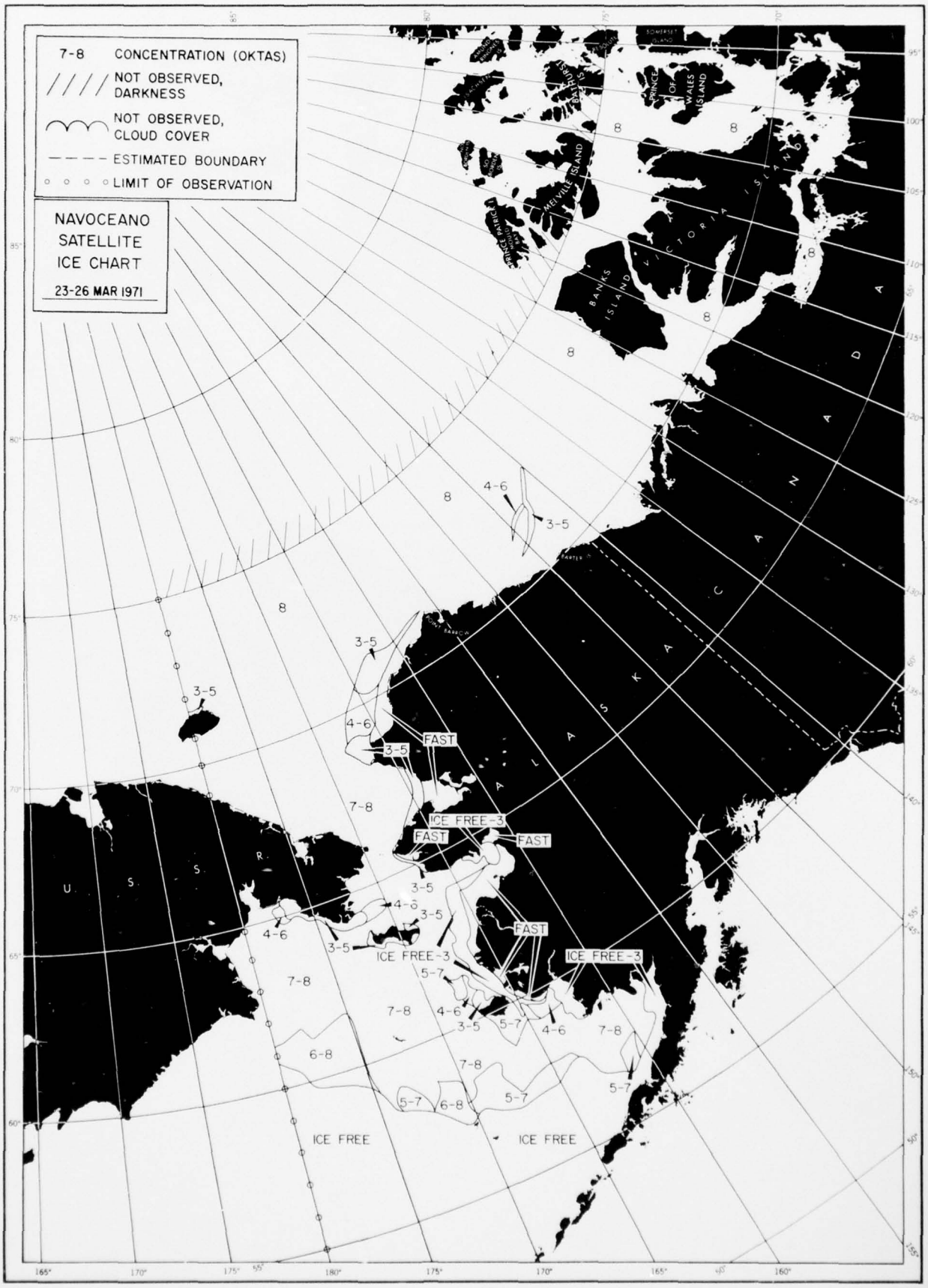
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
19-22 MAR 1971
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
DISCONTINUOUS LEAD
BAXTER 15
POINT BARROW
ALASKA
DISCONTINUOUS FLAW LEAD
FAST
U. S. S. R.
NOT OBSVD
ICE FREE -3
ICE FREE
ICE FREE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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
23-26 MAR 1971
U S S R
A L A S K A
C A N A D A
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
FAST
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ICE FREE
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6-8
5-7
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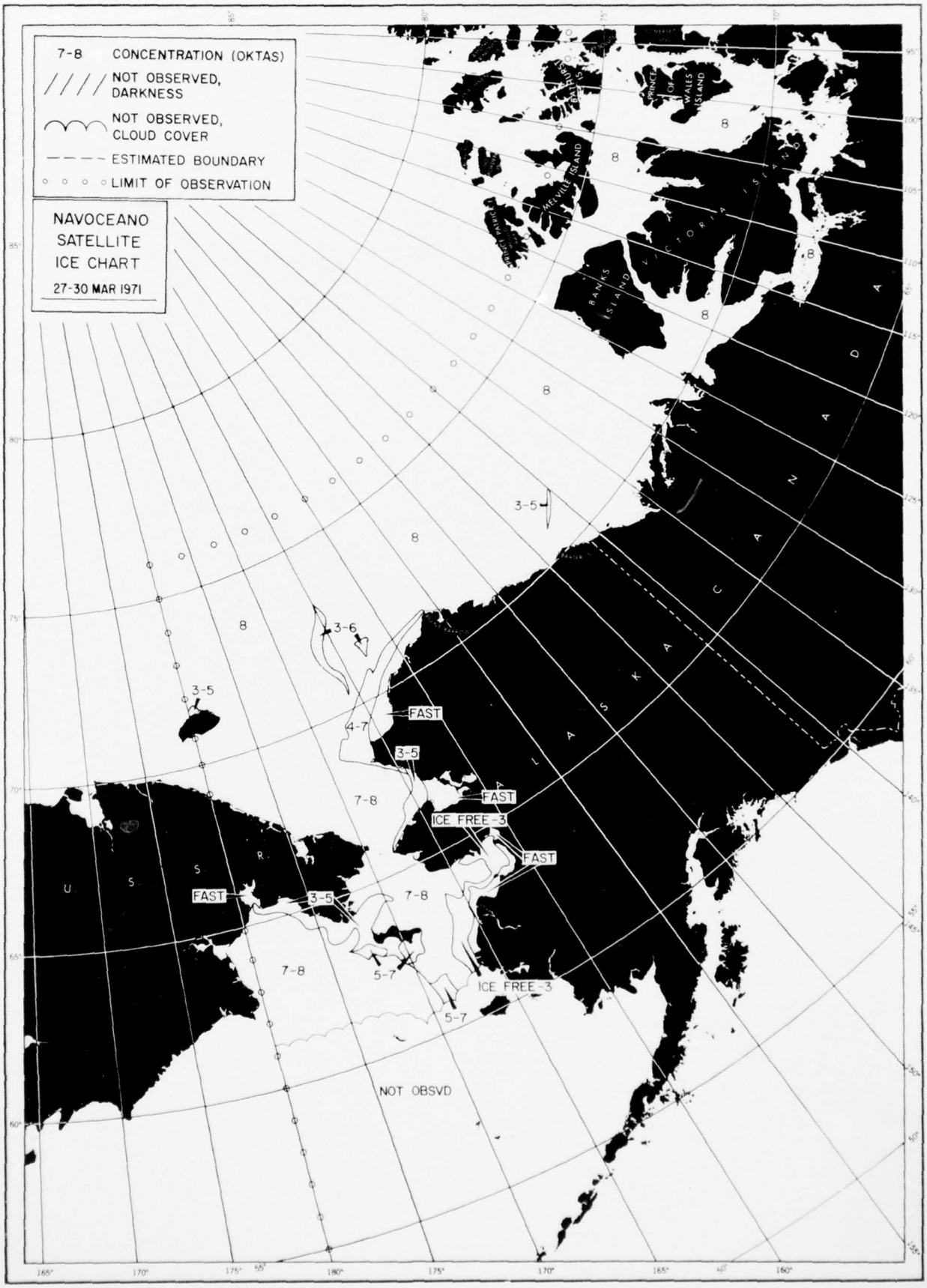
3-5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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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27-30 MAR 1971
BATHURST
PRINCE OF WALES ISLAND
MELVILLE ISLAND
VICTORIA ISLAND
BANKS ISLAND
CANADA
ALASKA
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8
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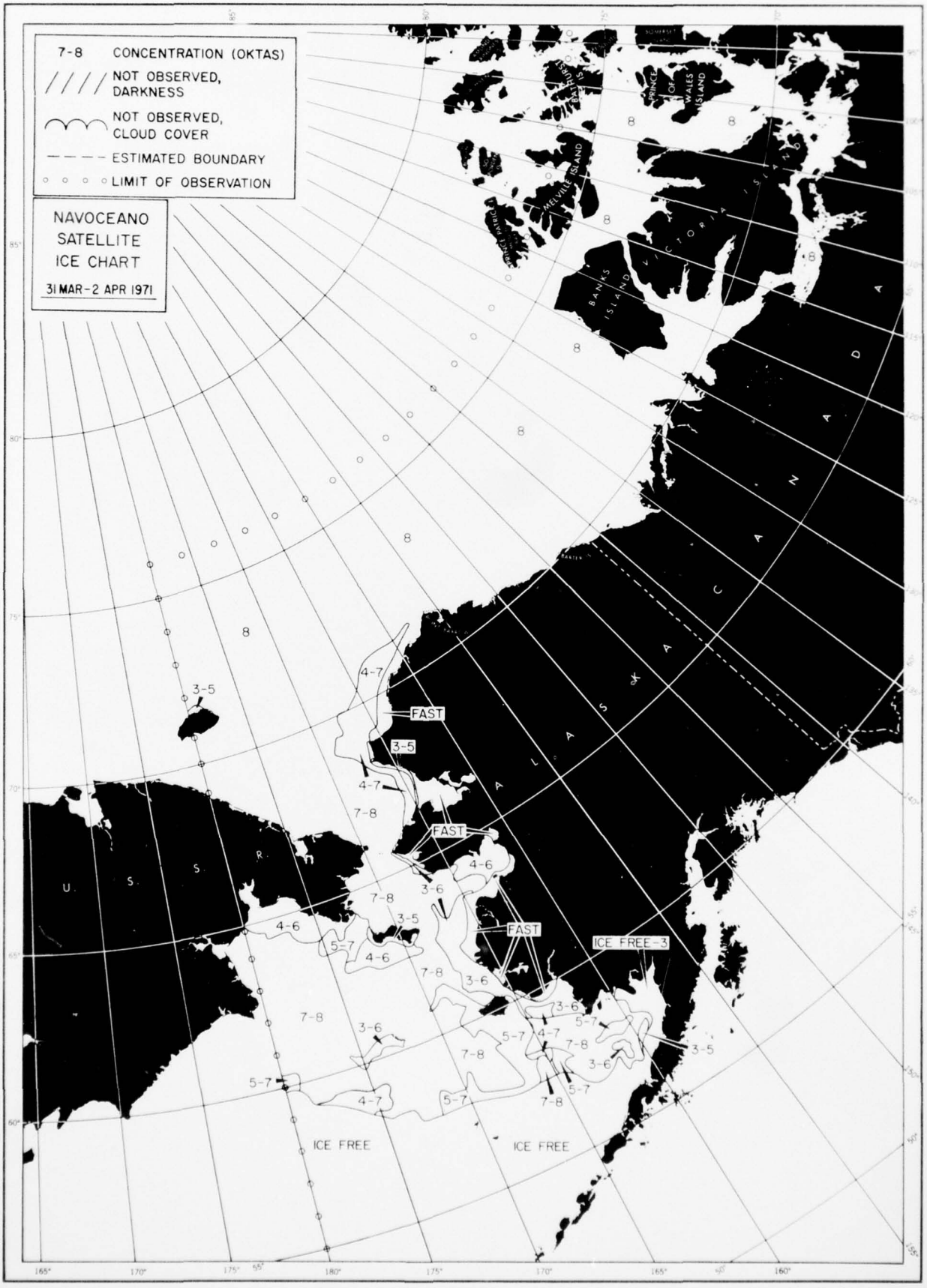
ICE FREE-3
5-7
NOT OBSVD


7-8 CONCENTRATION (OKTAS)
NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
31 MAR-2 APR 1971
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U.S.S.R.
FAST
ICE FREE-3
ICE FREE
ICE FREE
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FAST
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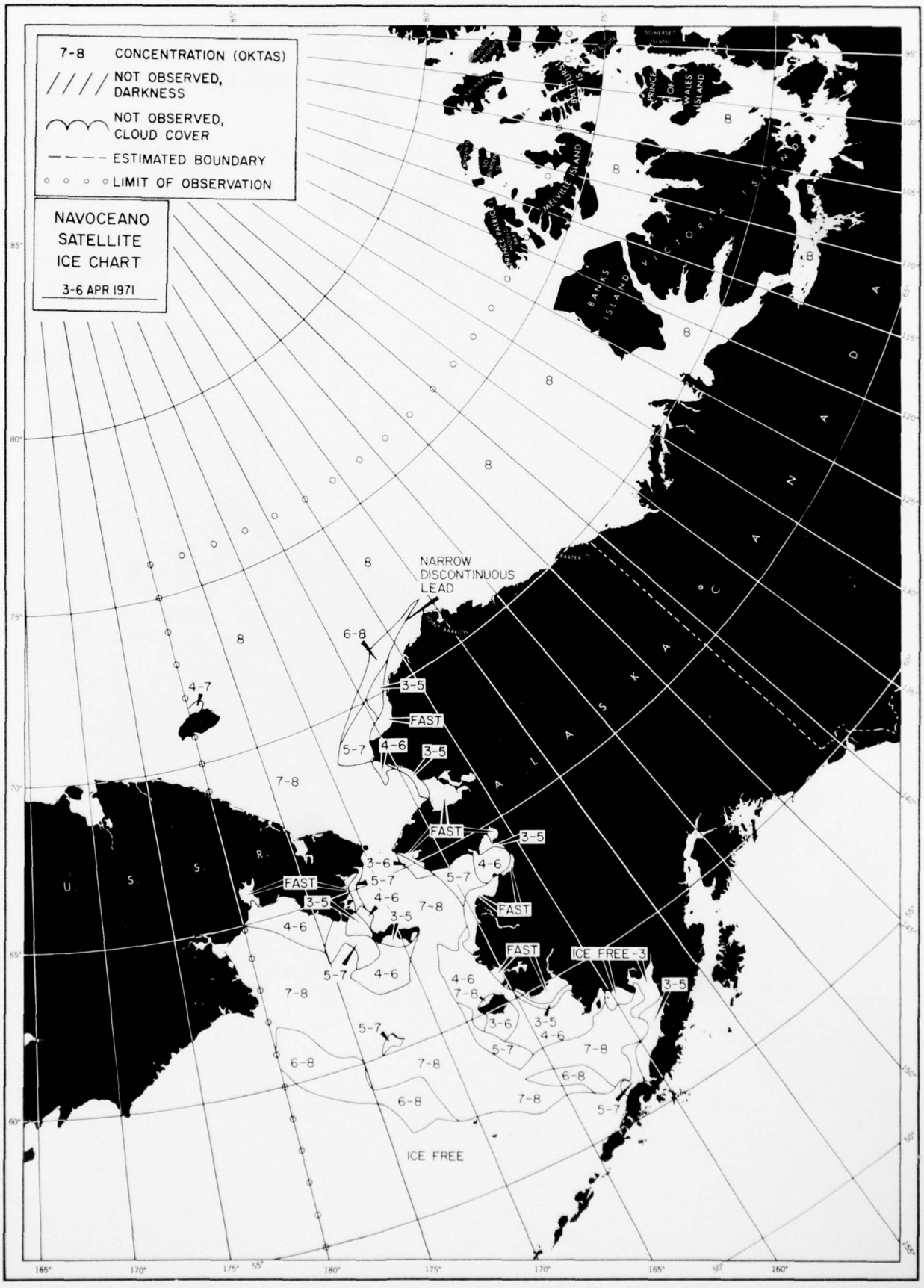
7-8 CONCENTRATION (OKTAS)
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
3-6 APR 1971
NARROW DISCONTINUOUS LEAD
ICE FREE
ICE FREE - 3
FAST
U S S R
A L A S K A
C A N A D A
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
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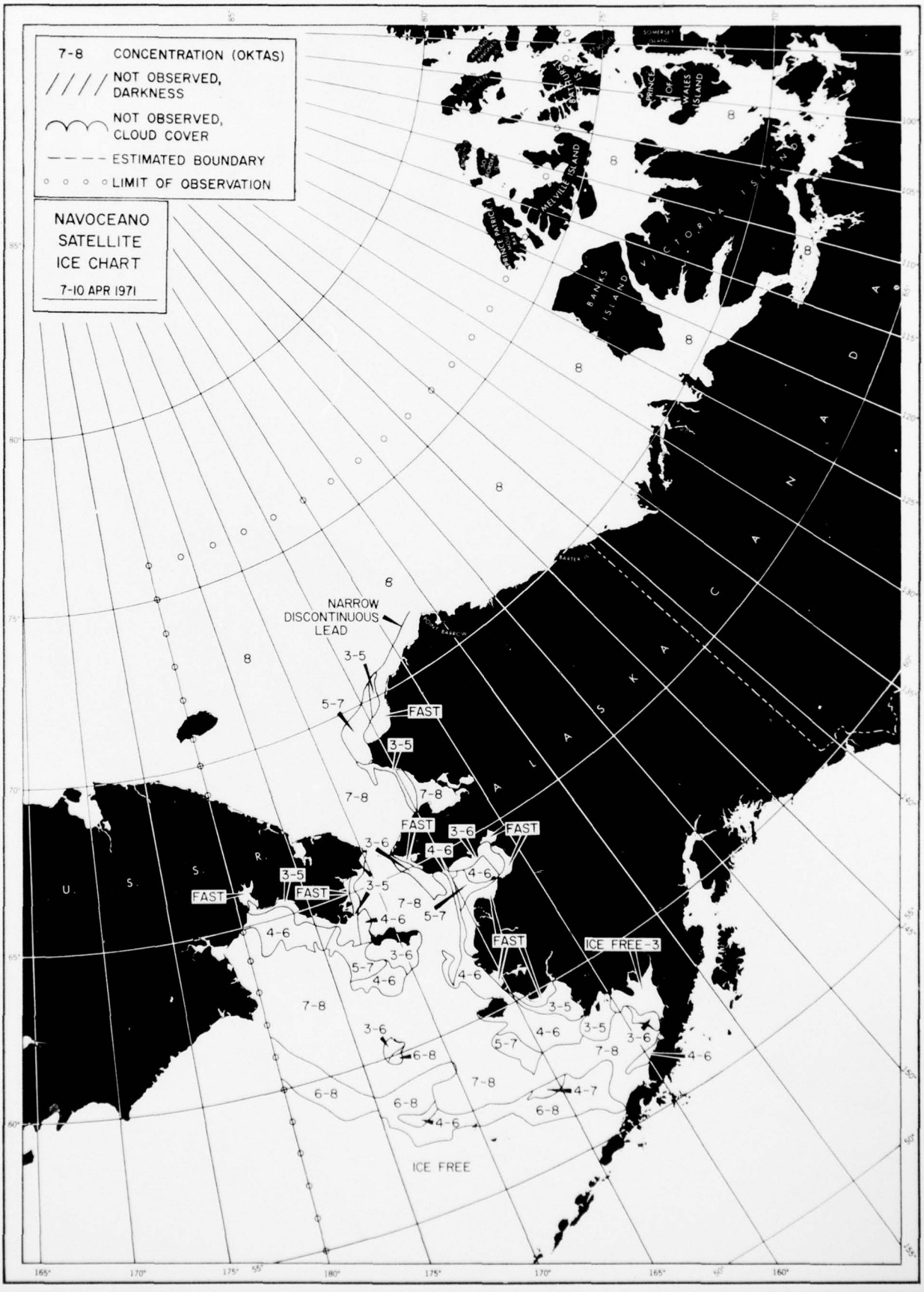
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
7-10 APR 1971
NARROW DISCONTINUOUS LEAD
FAST
ICE FREE-3
ICE FREE
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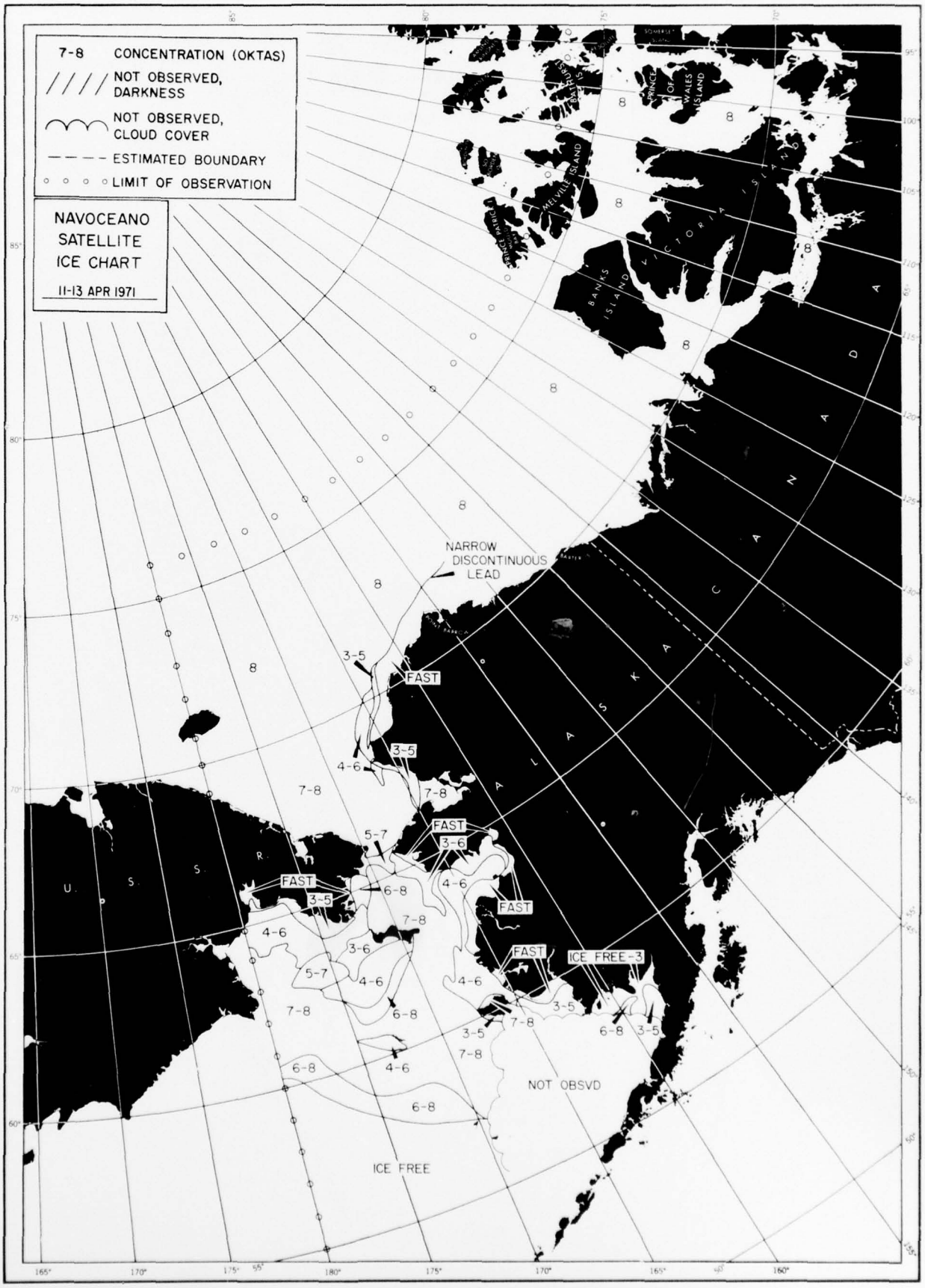
ALASKA
CANADA
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND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NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
11-13 APR 1971
NARROW DISCONTINUOUS LEAD
FAST
ICE FREE-3
NOT OBSVD
ICE FREE
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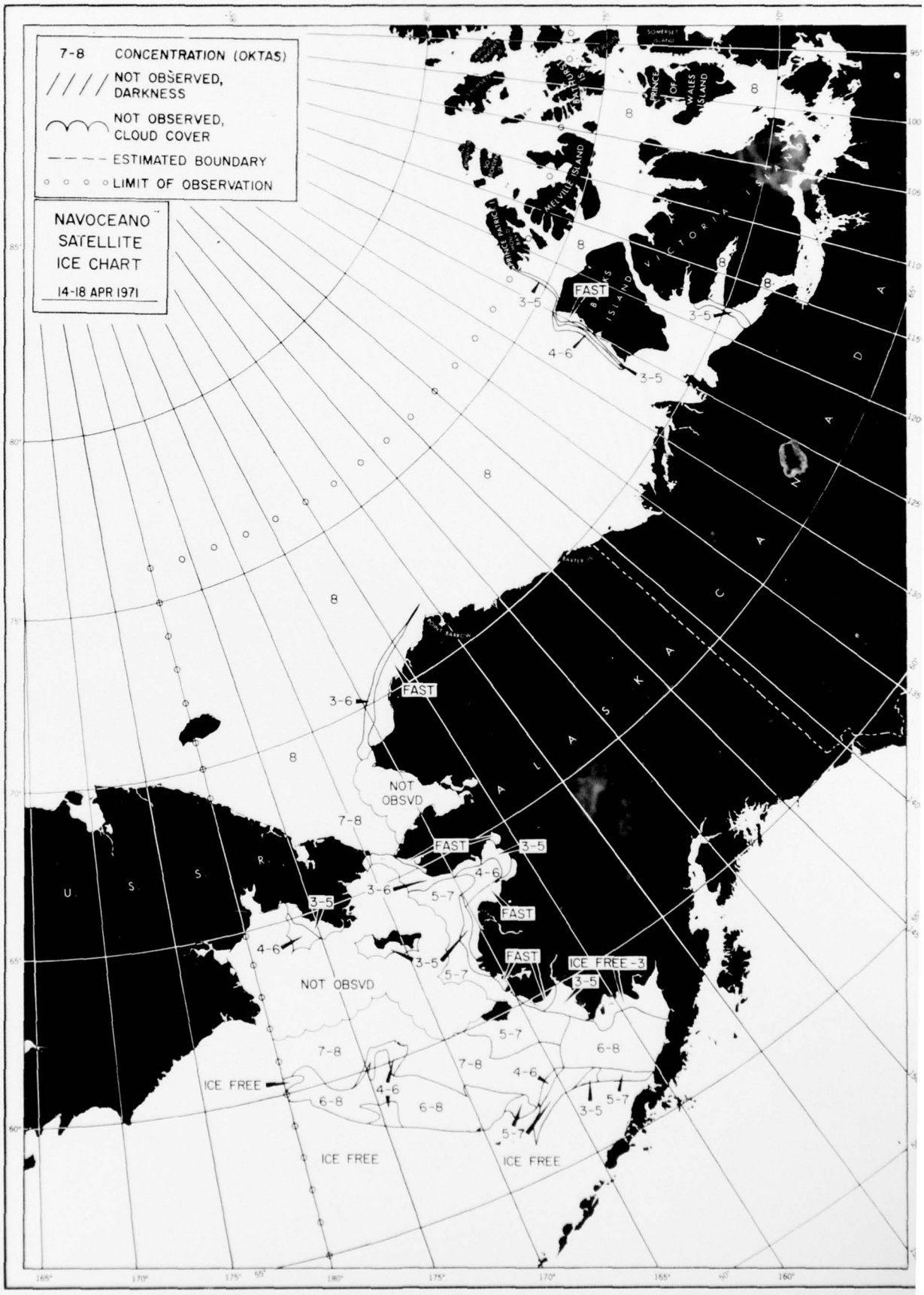
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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14-18 APR 1971
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
PRINCE PATRICK ISLAND
BANKS ISLAND
VICTORIA I.
CANADA
ALASKA
U S S R
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ICE FREE
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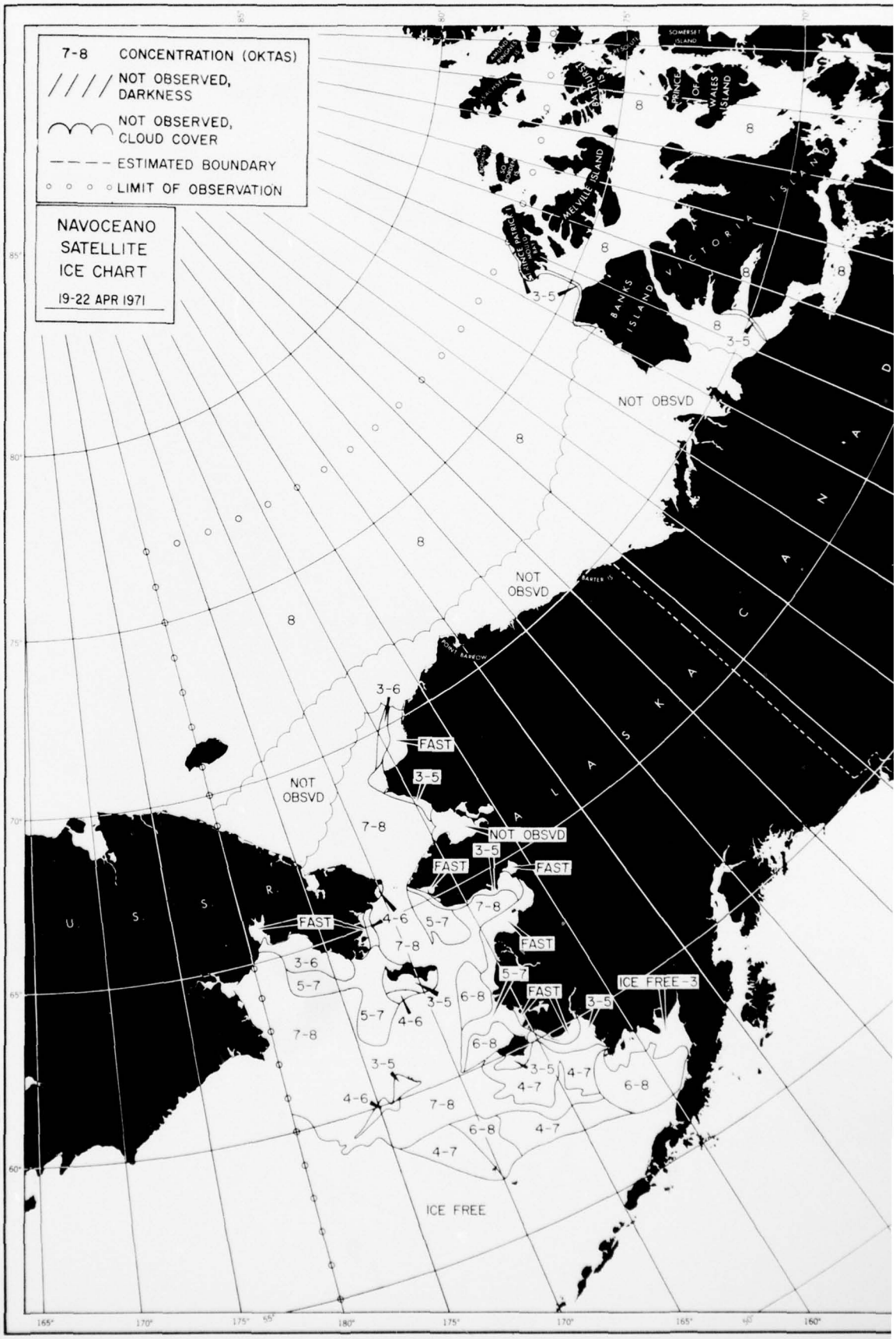
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
19-22 APR 1971
SOMERSET ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
PRINCE PATRICK ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U.S.S.R.
POINT BARROW
BARTER IS
NOT OBSVD
FAST
ICE FREE
ICE FREE -3
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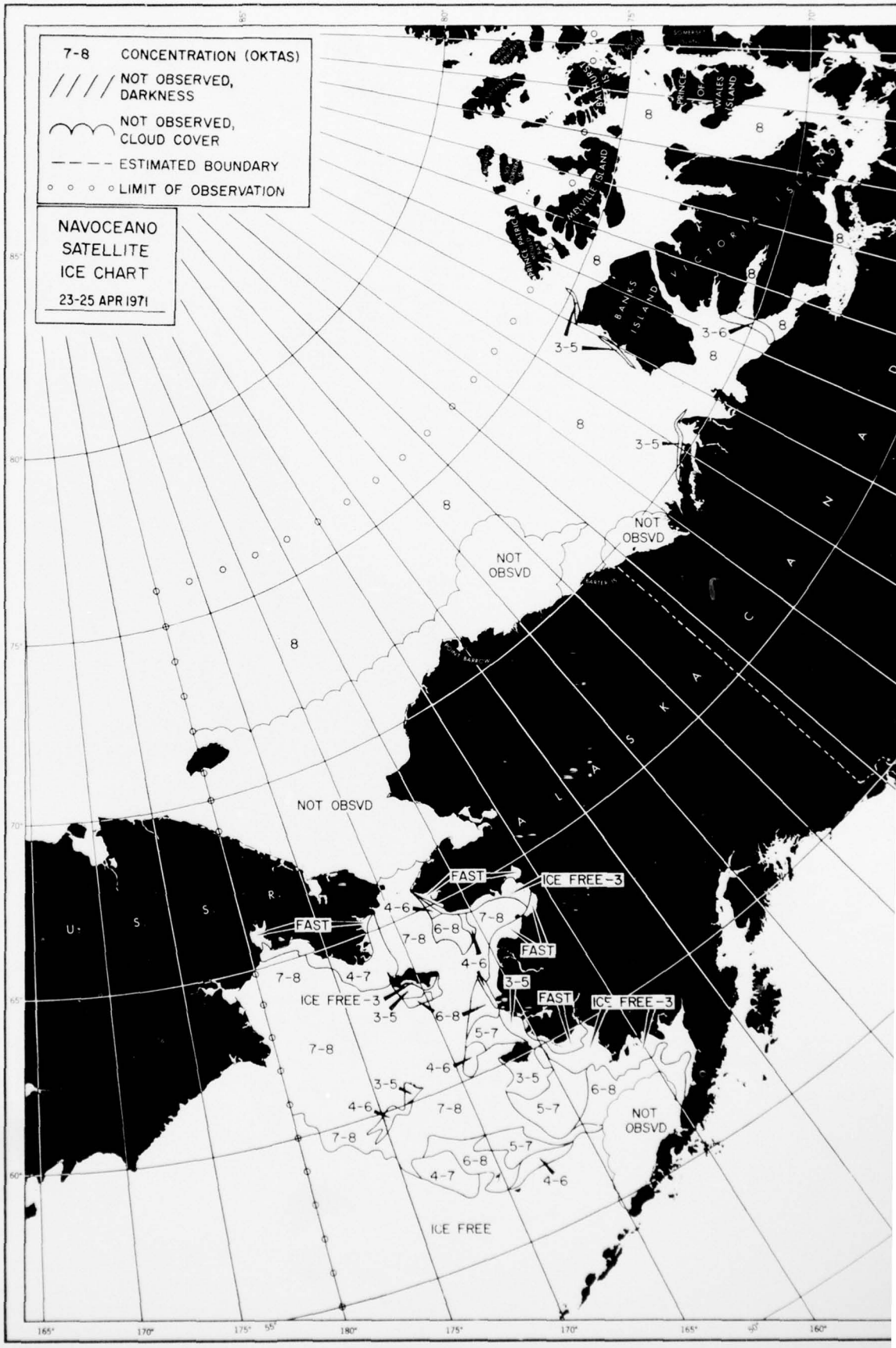
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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23-25 APR 1971
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U.S.S.R.
NOT OBSVD
FAST
ICE FREE-3
ICE FREE
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7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
26-29 APR 1971
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
NOT OBSVD
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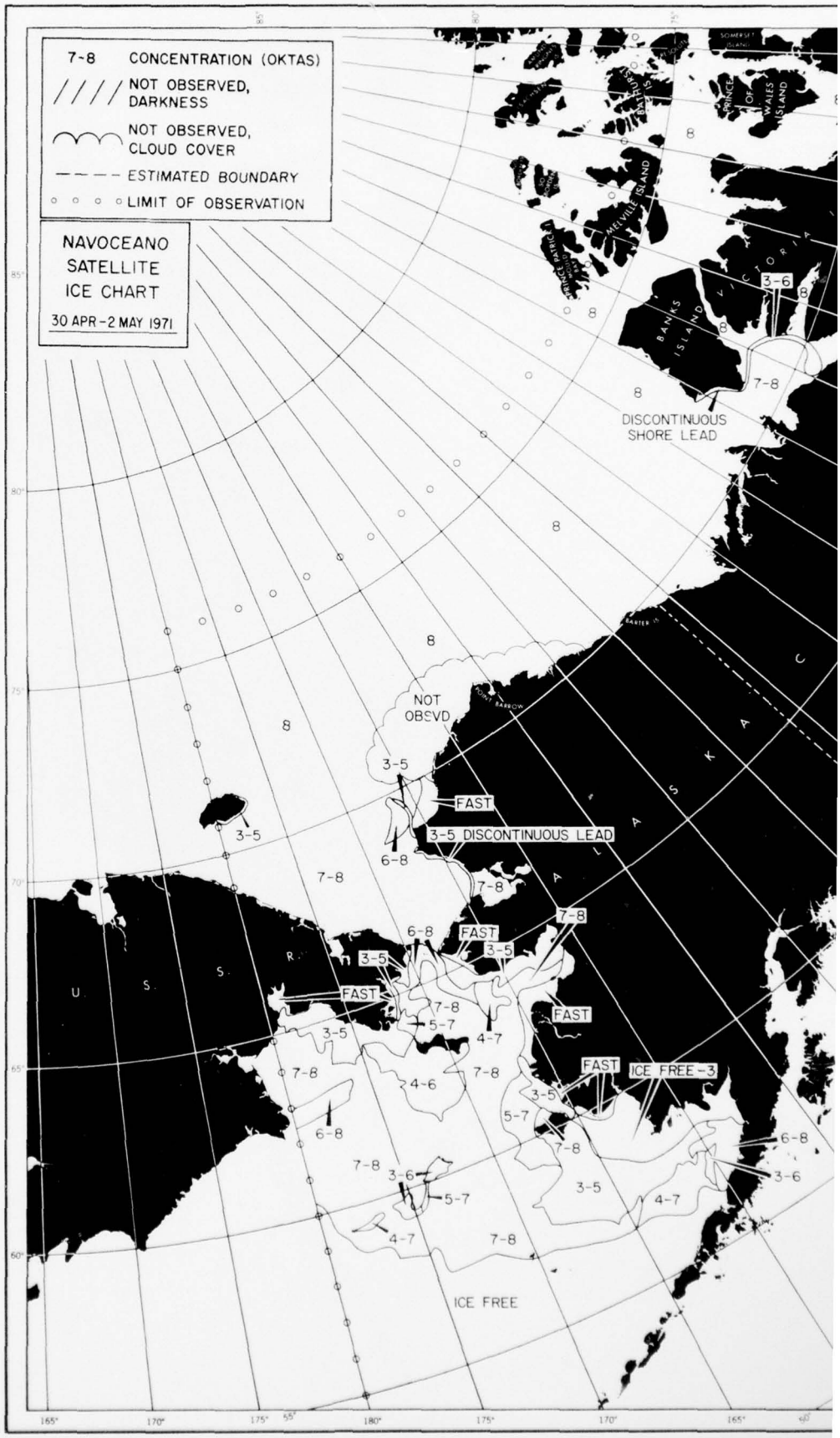
ICE FREE
U S S R
A L A S K A
C A N A D A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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
30 APR-2 MAY 1971
DISCONTINUOUS SHORE LEAD
NOT OBSVD
FAST
3-5 DISCONTINUOUS LEAD
ICE FREE-3
ICE FREE
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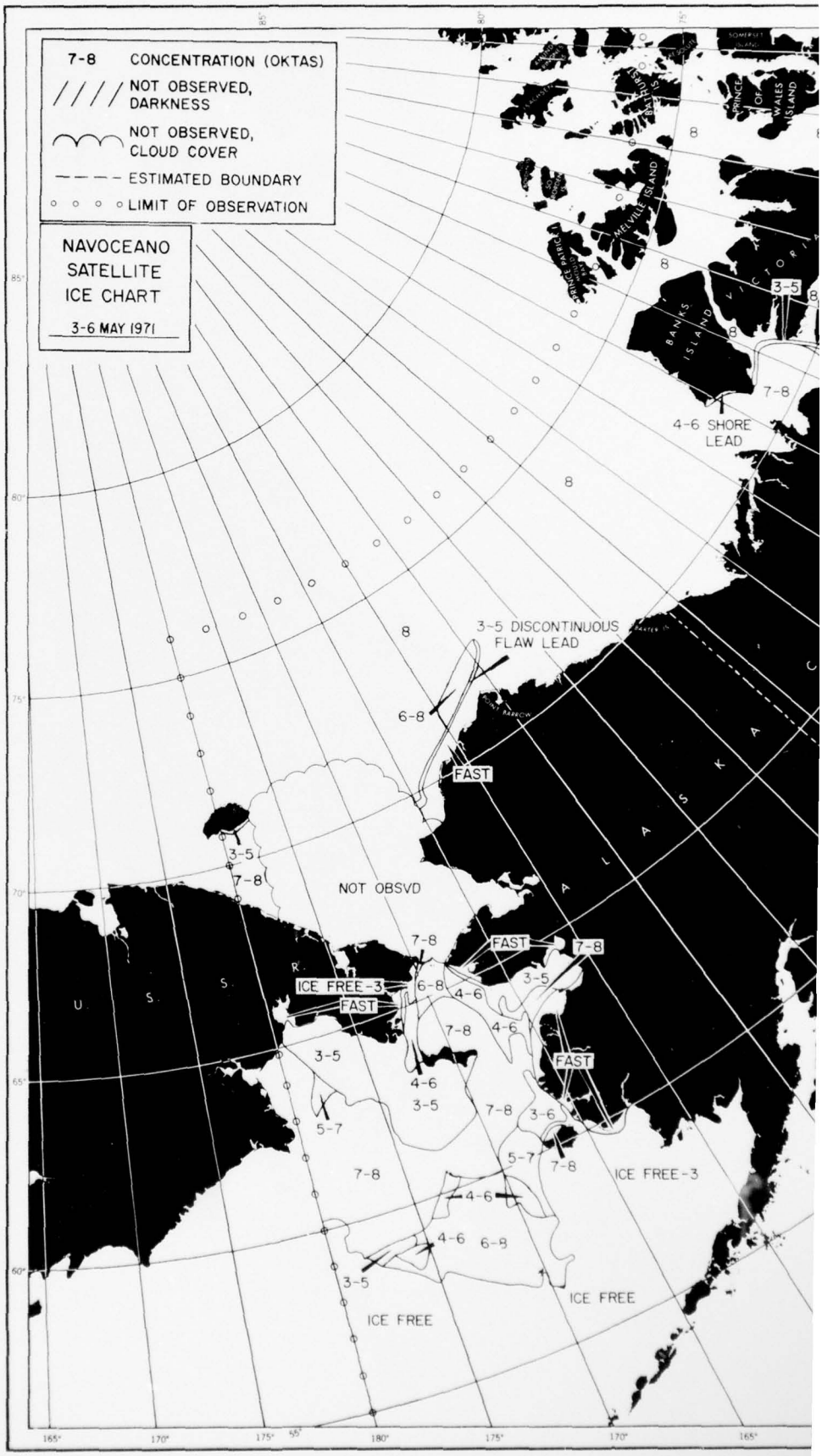
VICTORIA I.
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BARTER I.
POINT BARROW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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
3-6 MAY 1971
BANKS ISLAND
VICTORIA
MELVILLE ISLAND
PRINCE PATRICK ISLAND
PRINCE OF WALES ISLAND
4-6 SHORE LEAD
3-5 DISCONTINUOUS FLAW LEAD
FAST
NOT OBSVD
ICE FREE-3
ICE FREE
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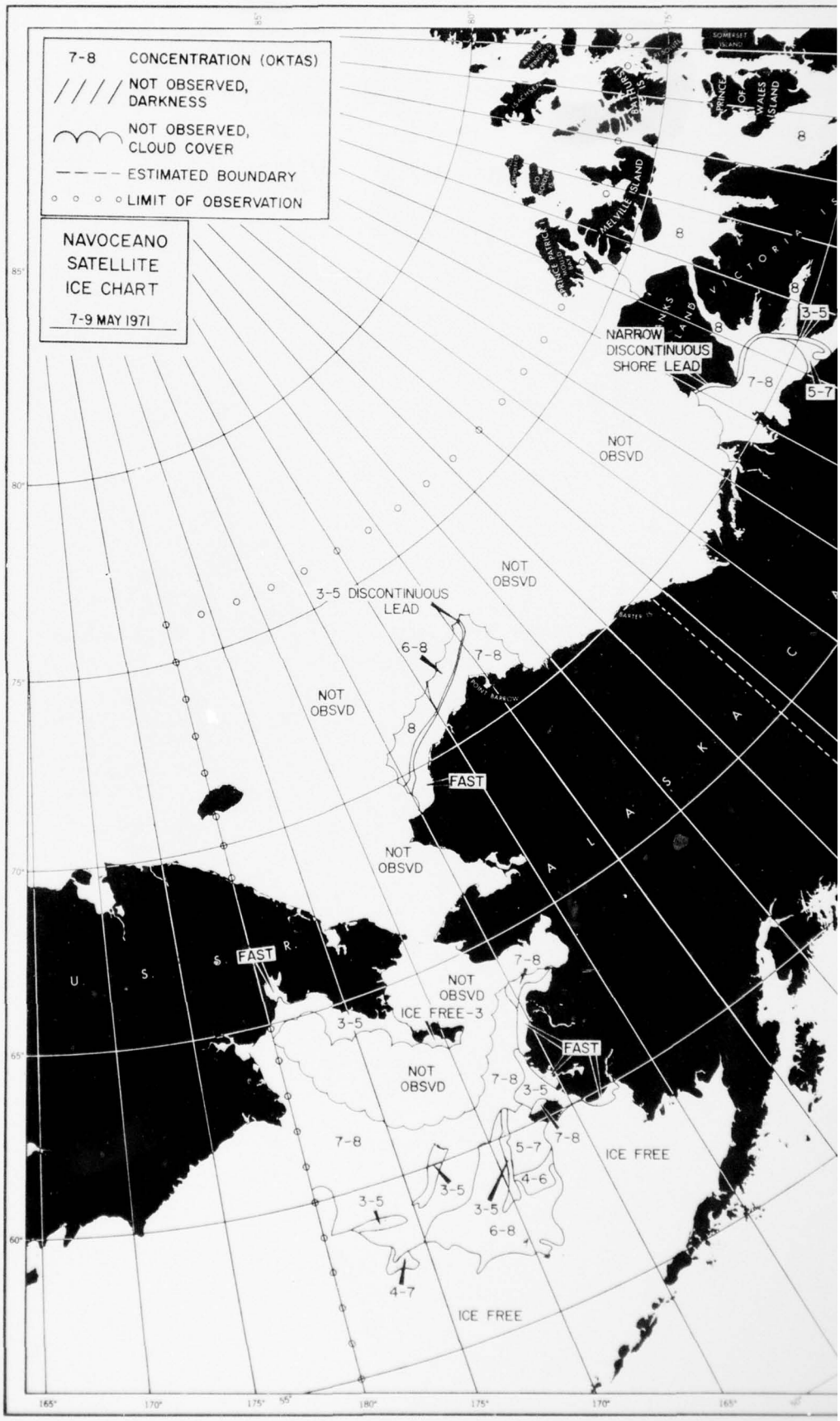
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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7-9 MAY 1971
NARROW DISCONTINUOUS SHORE LEAD
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NOT OBSVD
3-5 DISCONTINUOUS LEAD
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FAST
ICE FREE-3
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4-7
ICE FREE
U. S. S. R.
A L A S K A
BARTER IS.
PRINCE OF WALES ISLAND
MELVILLE ISLAND
PRINCE PATRICK ISLAND
BANKS ISLAND
VICTORIA I.
SOMERSET ISLAND
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AD-A042 709 NAVAL OCEANOGRAPHIC OFFICE WASHINGTON D C F/G 8/12
REPORT OF THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM-1971--ETC(U)
MAY 74 P A MITCHELL
UNCLASSIFIED N00-SP-70(71) NL

3 OF 3
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9-77
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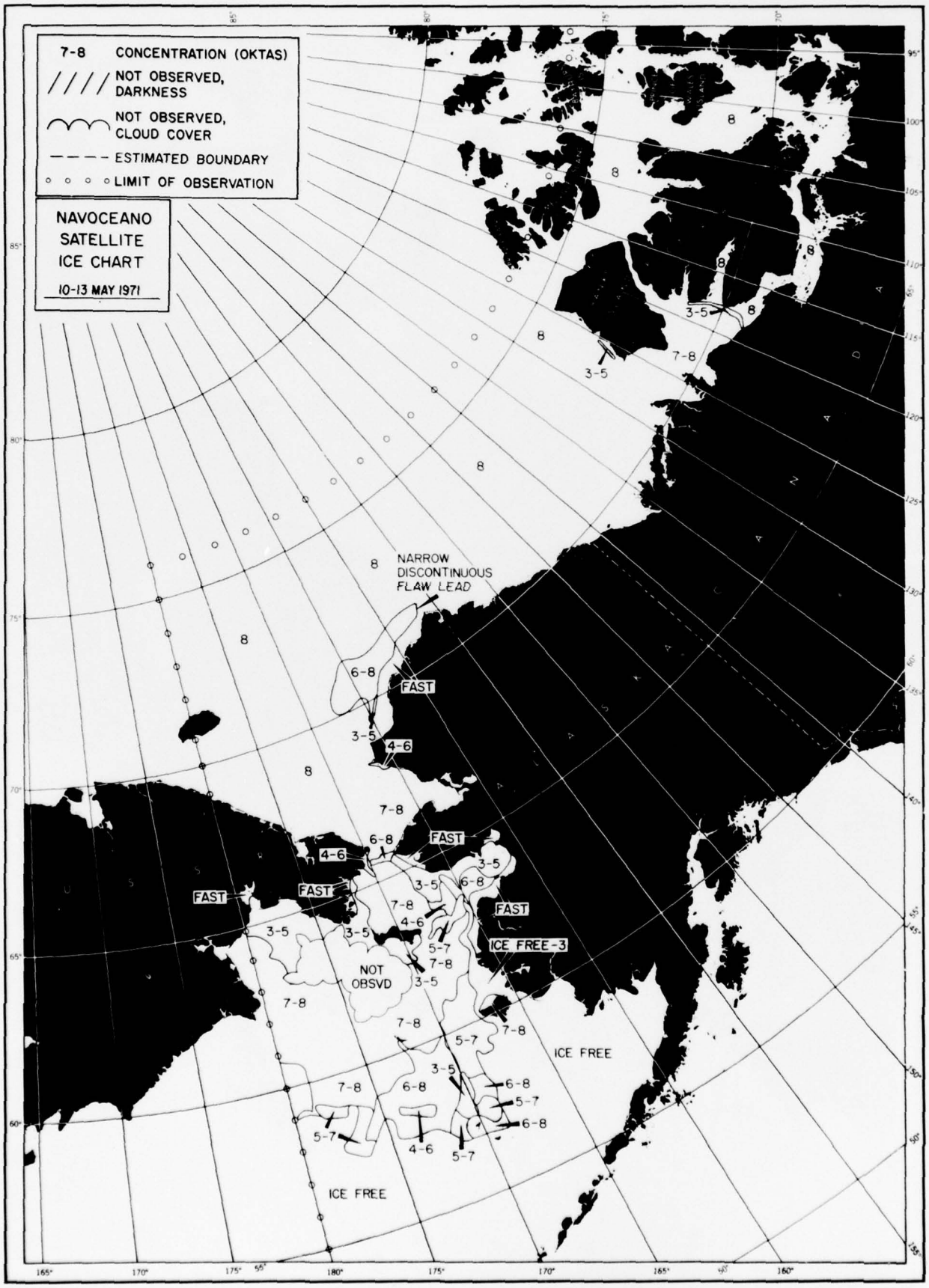
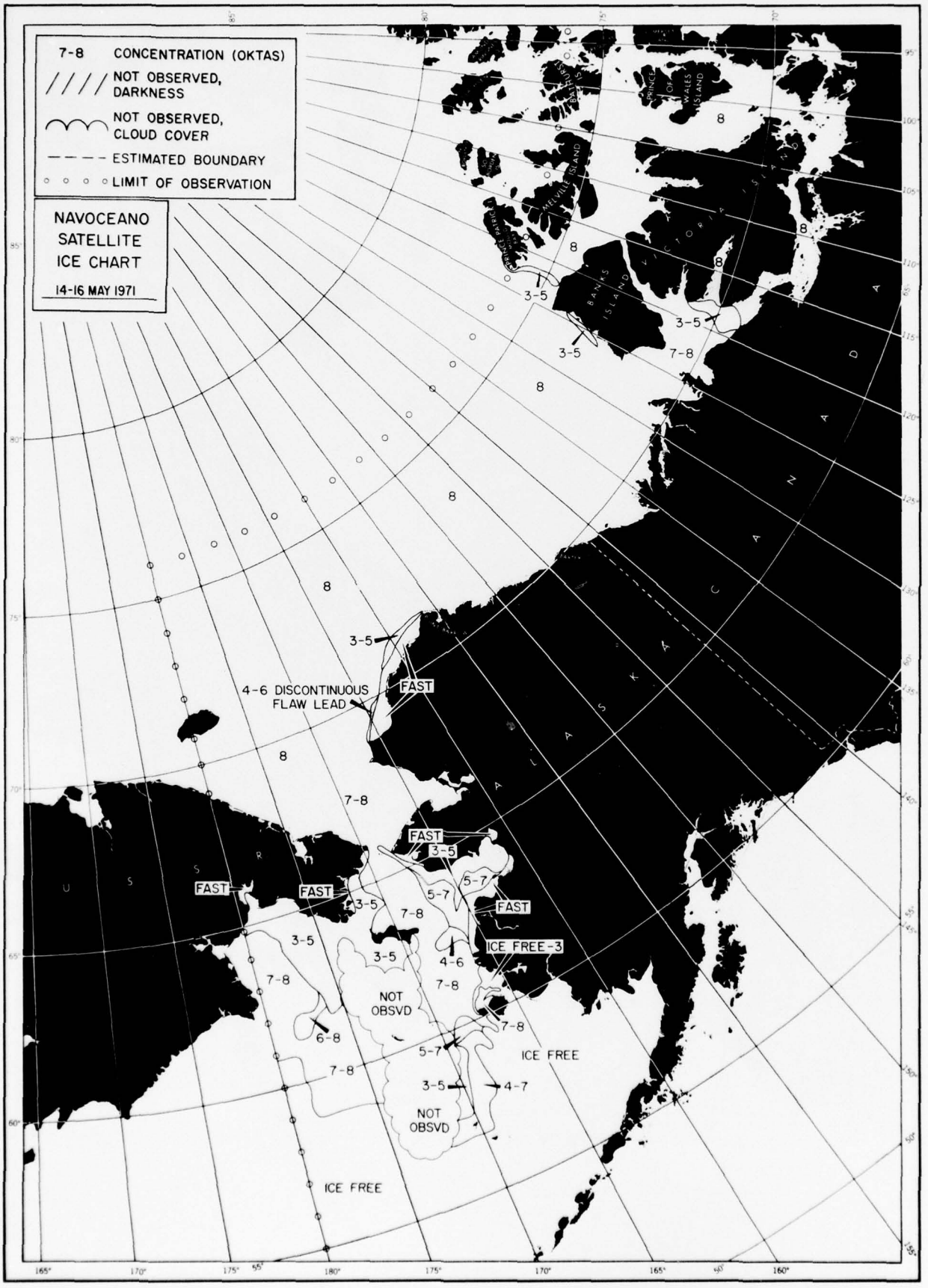

7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
10-13 MAY 1971
NARROW DISCONTINUOUS FLAW LEAD
FAST
ICE FREE-3
NOT OBSVD
ICE FREE
ICE FREE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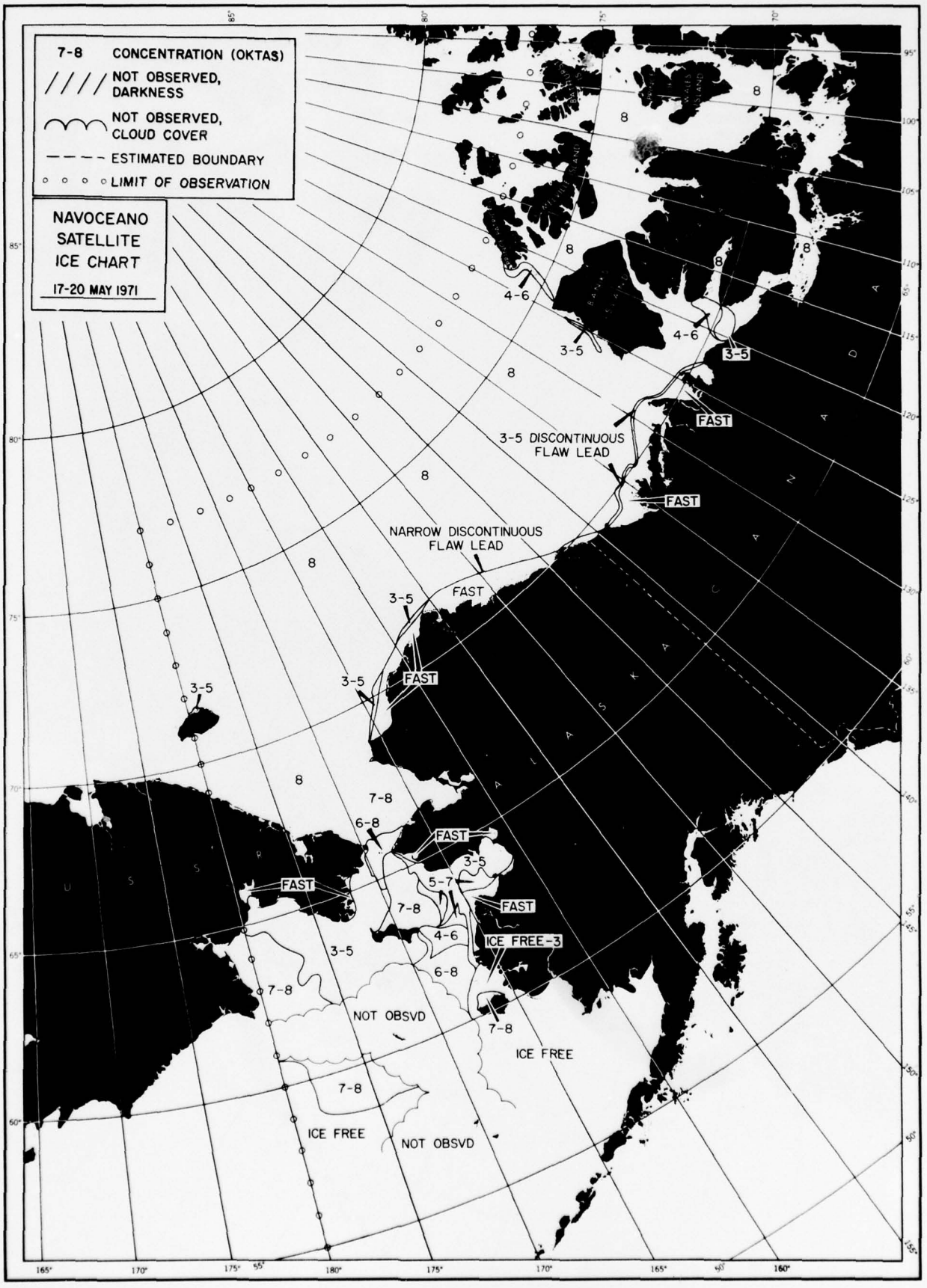
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
14-16 MAY 1971
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U S S R
8
7-8
6-8
5-7
4-7
4-6
3-5
FAST
4-6 DISCONTINUOUS FLAW LEAD
ICE FREE-3
NOT OBSVD
ICE FREE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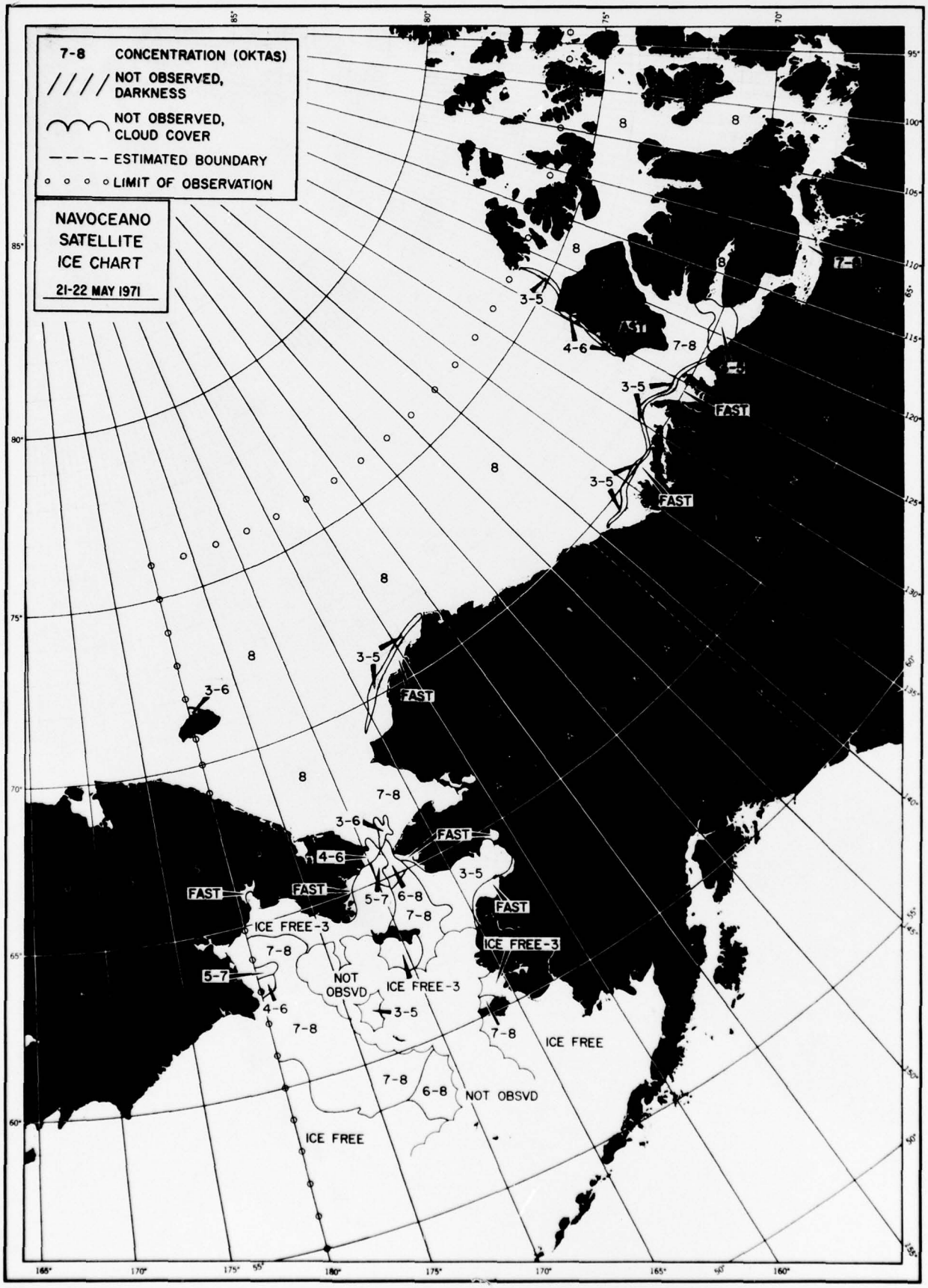
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
17-20 MAY 1971
8
4-6
3-5
FAST
3-5 DISCONTINUOUS FLAW LEAD
NARROW DISCONTINUOUS FLAW LEAD
7-8
6-8
5-7
ICE FREE-3
NOT OBSVD
ICE FREE
U S S R
A L A S K A
C A N A D A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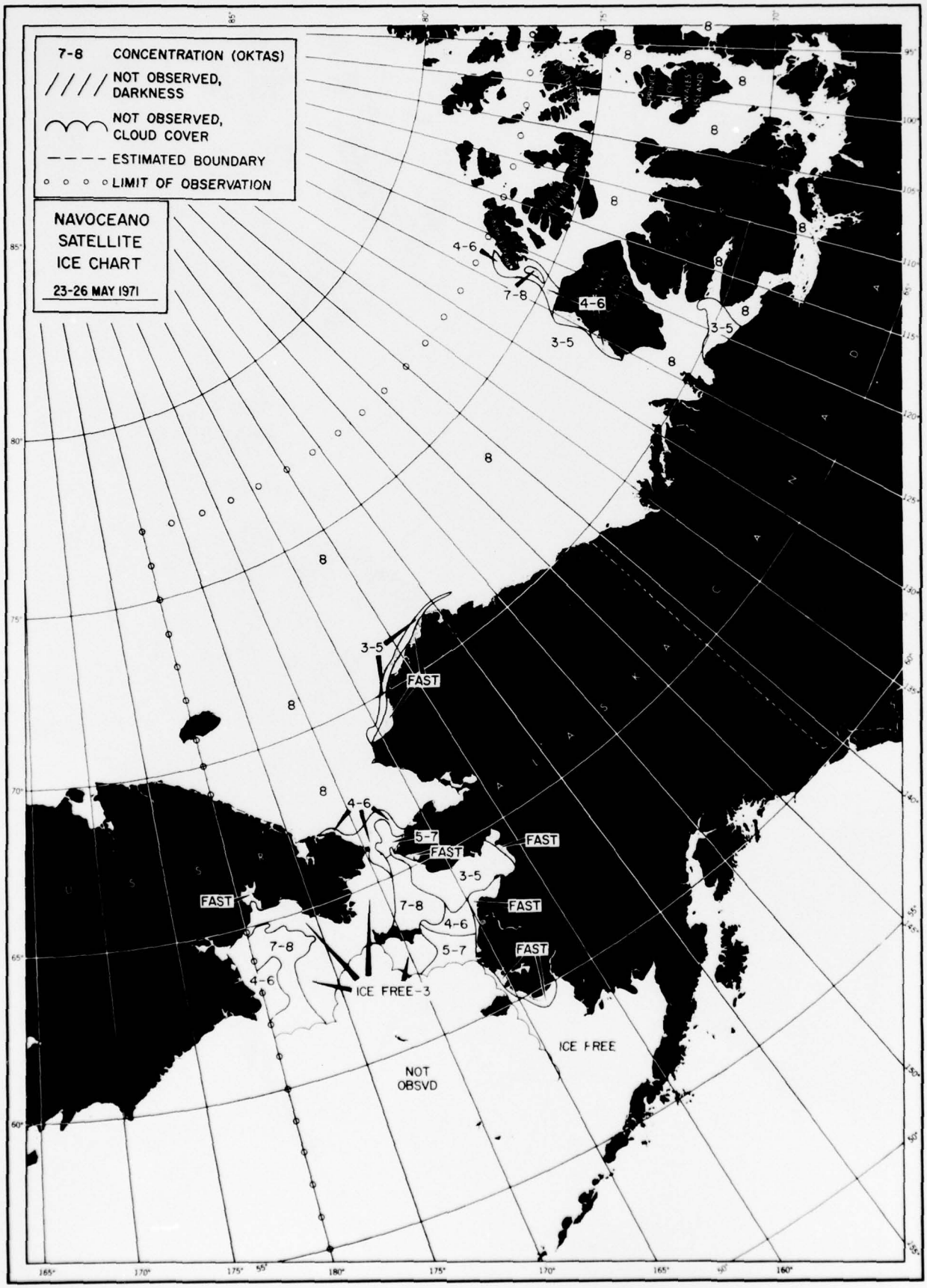
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
21-22 MAY 1971
8
3-5
4-6
7-8
FAST
3-6
7-8
5-7
6-8
ICE FREE-3
NOT OBSVD
ICE FREE
85°
80°
75°
70°
65°
60°
55°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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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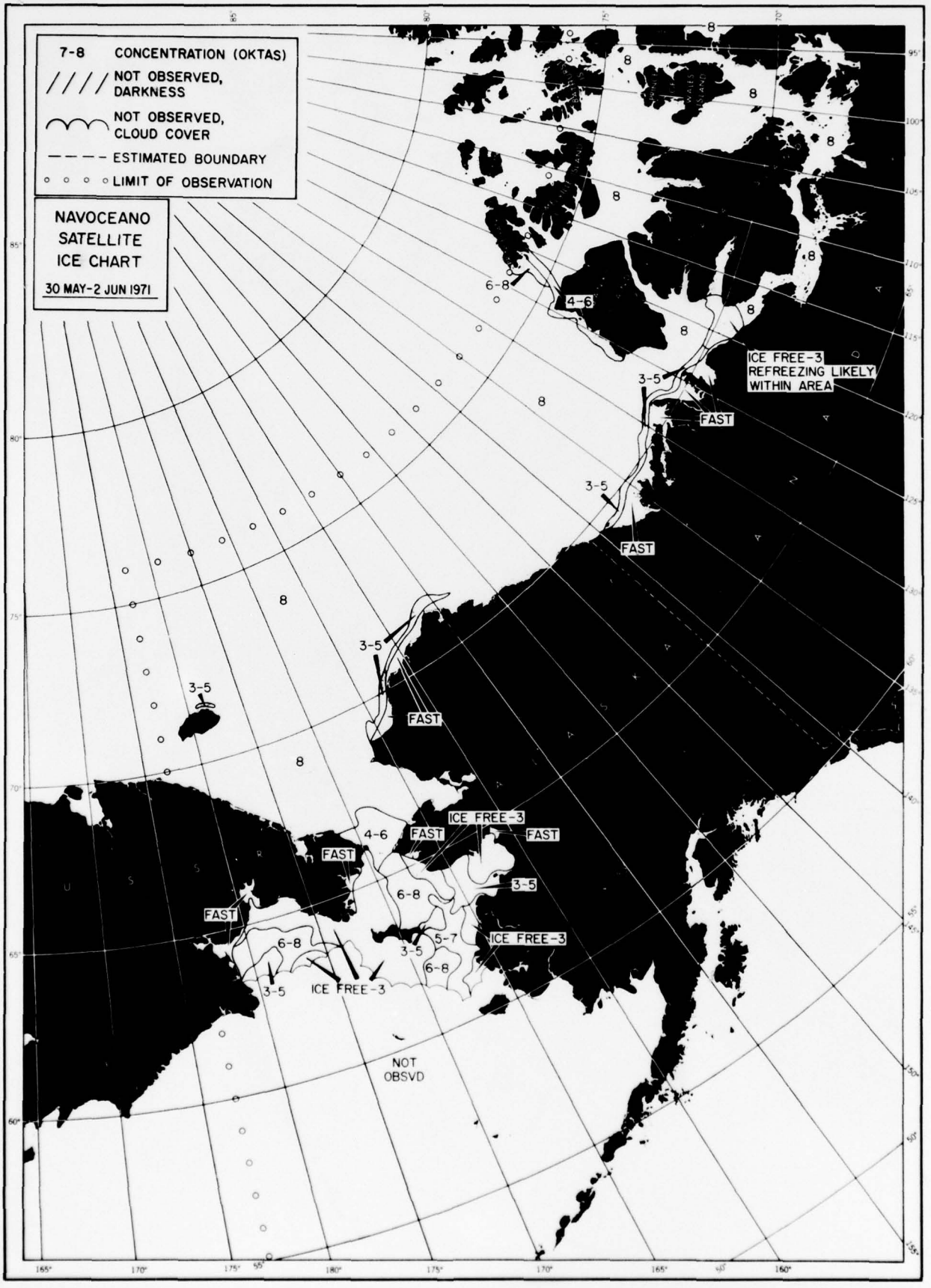
23-26 MAY 1971
8
4-6
7-8
3-5
FAST
5-7
ICE FREE-3
ICE FREE
NOT OBSVD
U S S R
A L A S K A
C A N A D A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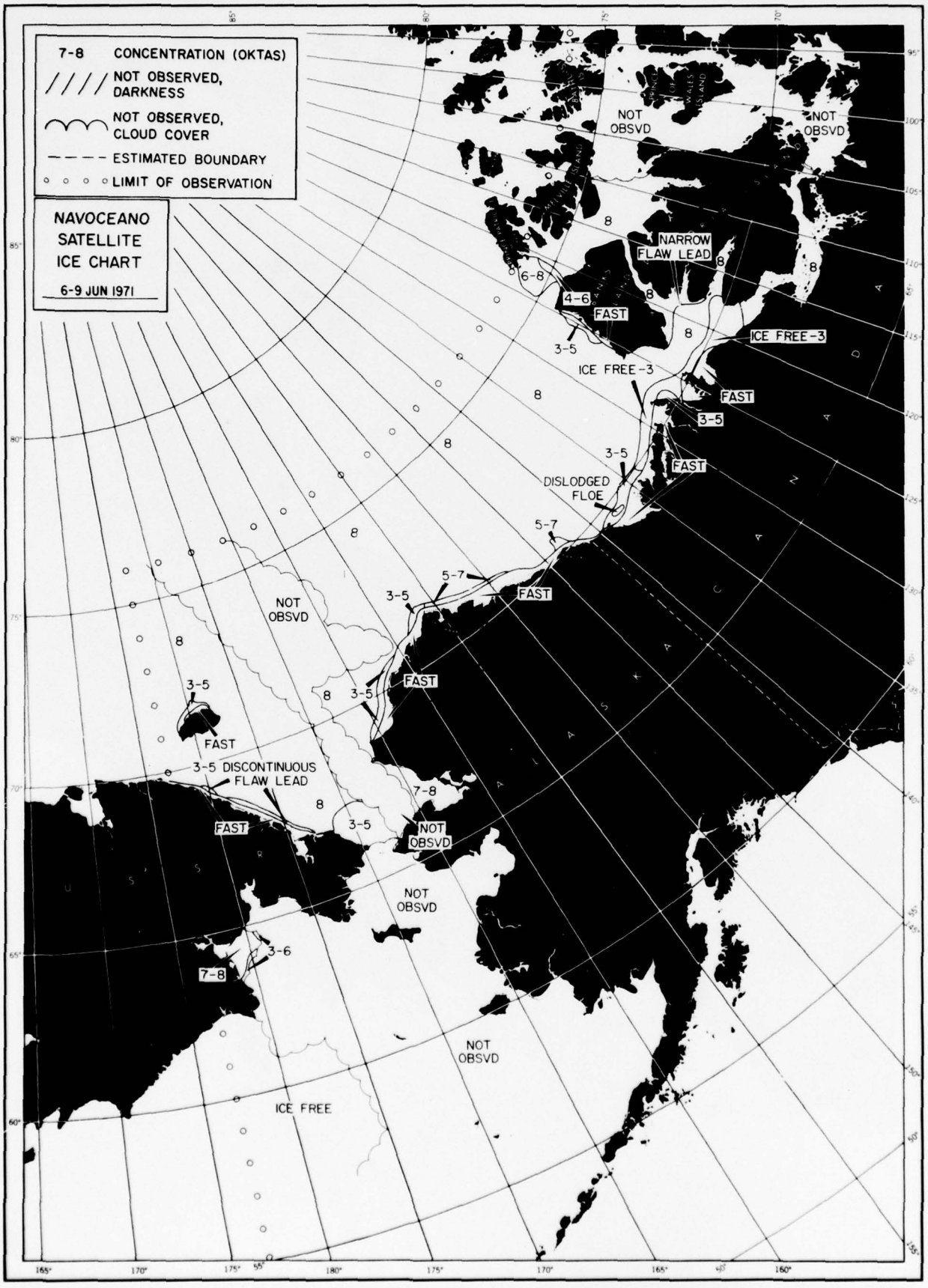
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
30 MAY-2 JUN 1971
8
6-8
4-6
3-5
FAST
ICE FREE-3
REFREEZING LIKELY WITHIN AREA
5-7
NOT OBSVD
U S S R
A L A S K A


7-8 CONCENTRATION (OKTAS)
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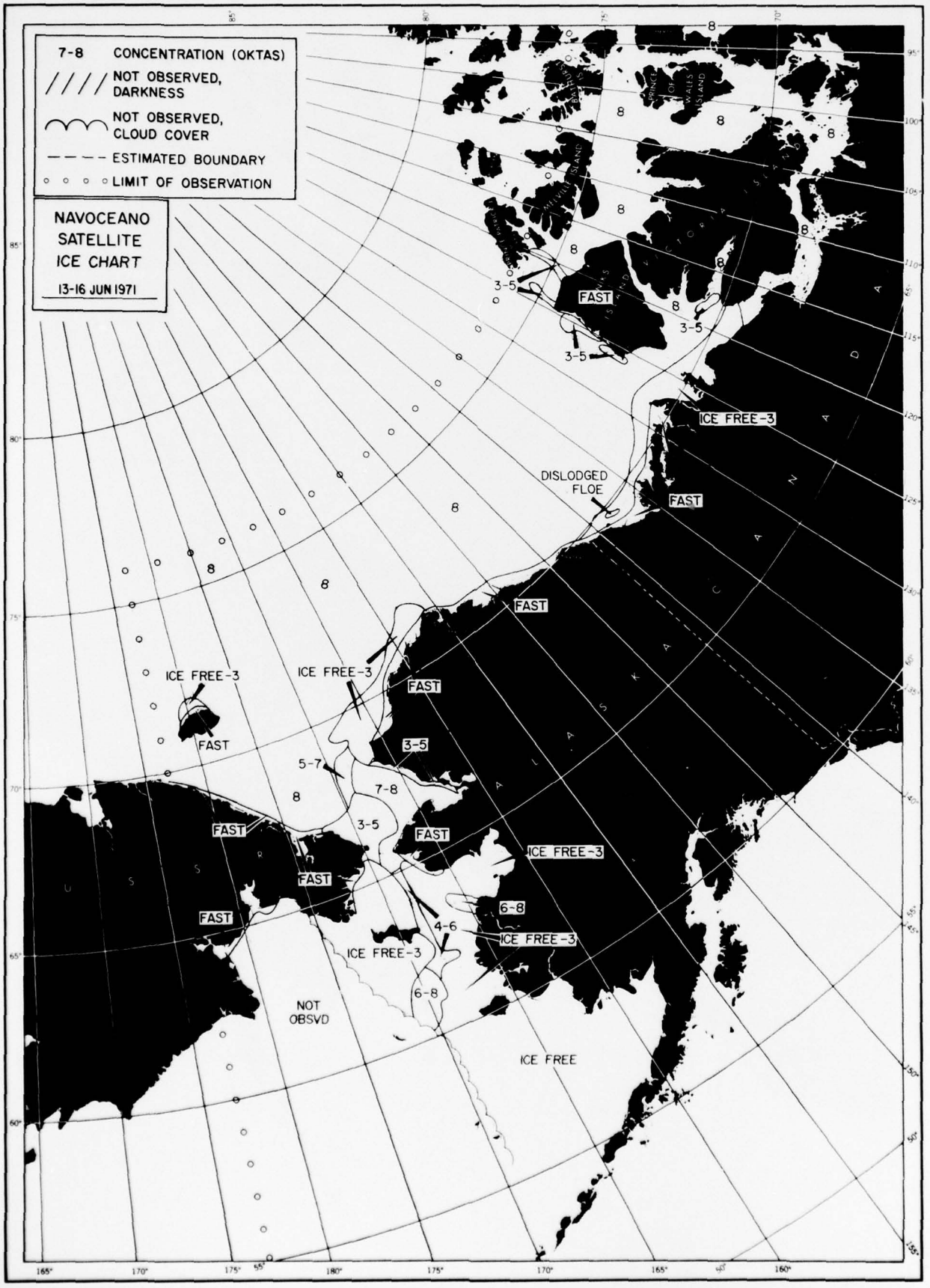
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
6-9 JUN 1971
NOT OBSVD
NOT OBSVD
NARROW FLAW LEAD
6-8
4-6
FAST
3-5
ICE FREE-3
ICE FREE-3
FAST
3-5
3-5
FAST
DISLODGED FLOE
5-7
5-7
3-5
FAST
NOT OBSVD
3-5
FAST
3-5
FAST
3-5 DISCONTINUOUS FLAW LEAD
FAST
7-8
3-5
NOT OBSVD
NOT OBSVD
3-6
7-8
NOT OBSVD
ICE FREE
8
U S S R
A L A S K A
C A N A D A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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
13-16 JUN 1971
BANKS ISLAND
PRINCE OF WALES ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U S S R
8
3-5
FAST
ICE FREE-3
DISLODGED FLOE
5-7
7-8
6-8
4-6
NOT OBSVD
ICE FREE
165°
170°
175°
180°
55°
60°
65°
70°
75°
80°
85°
90°
95°
100°
105°
110°
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145°
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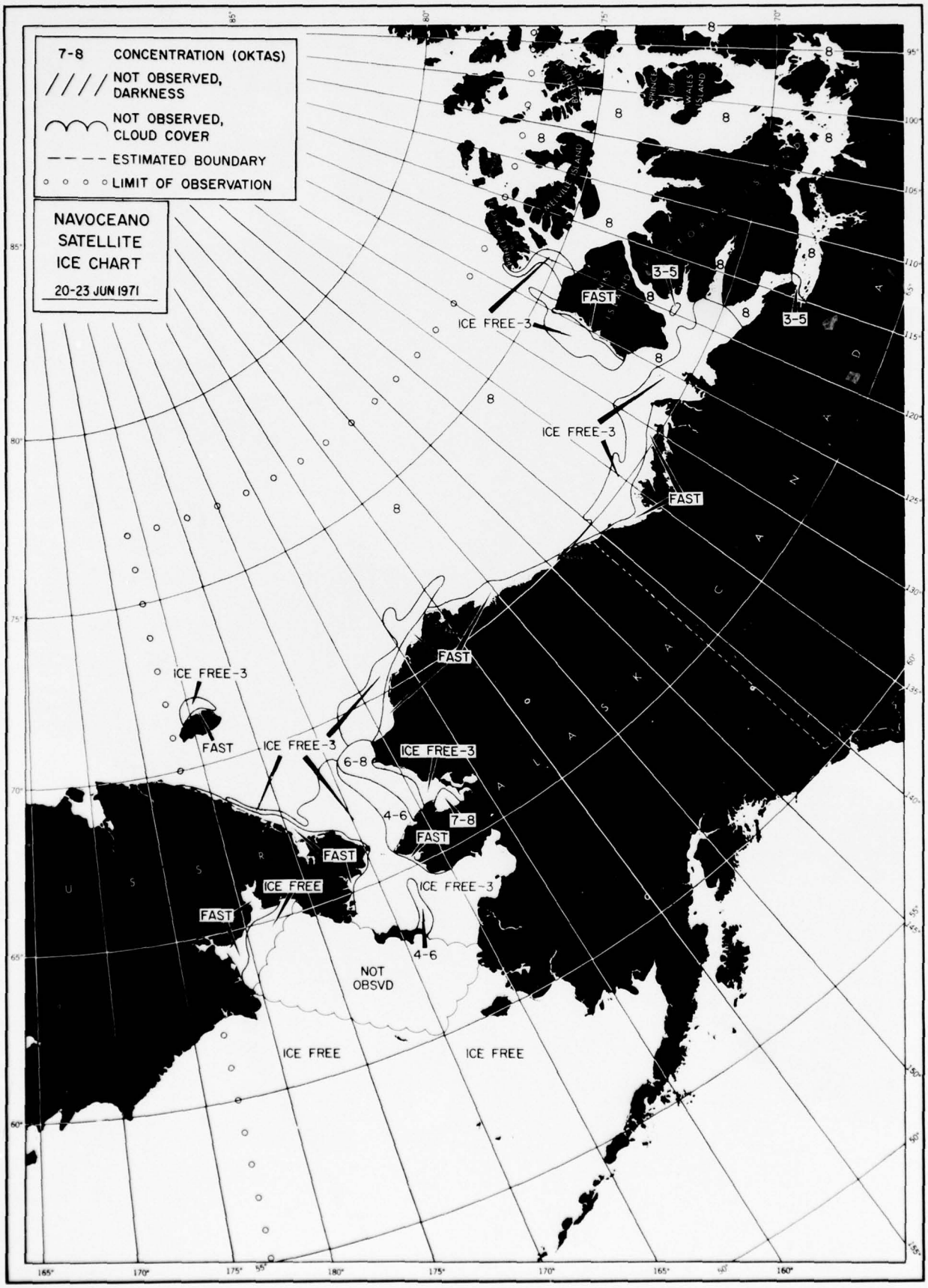
160°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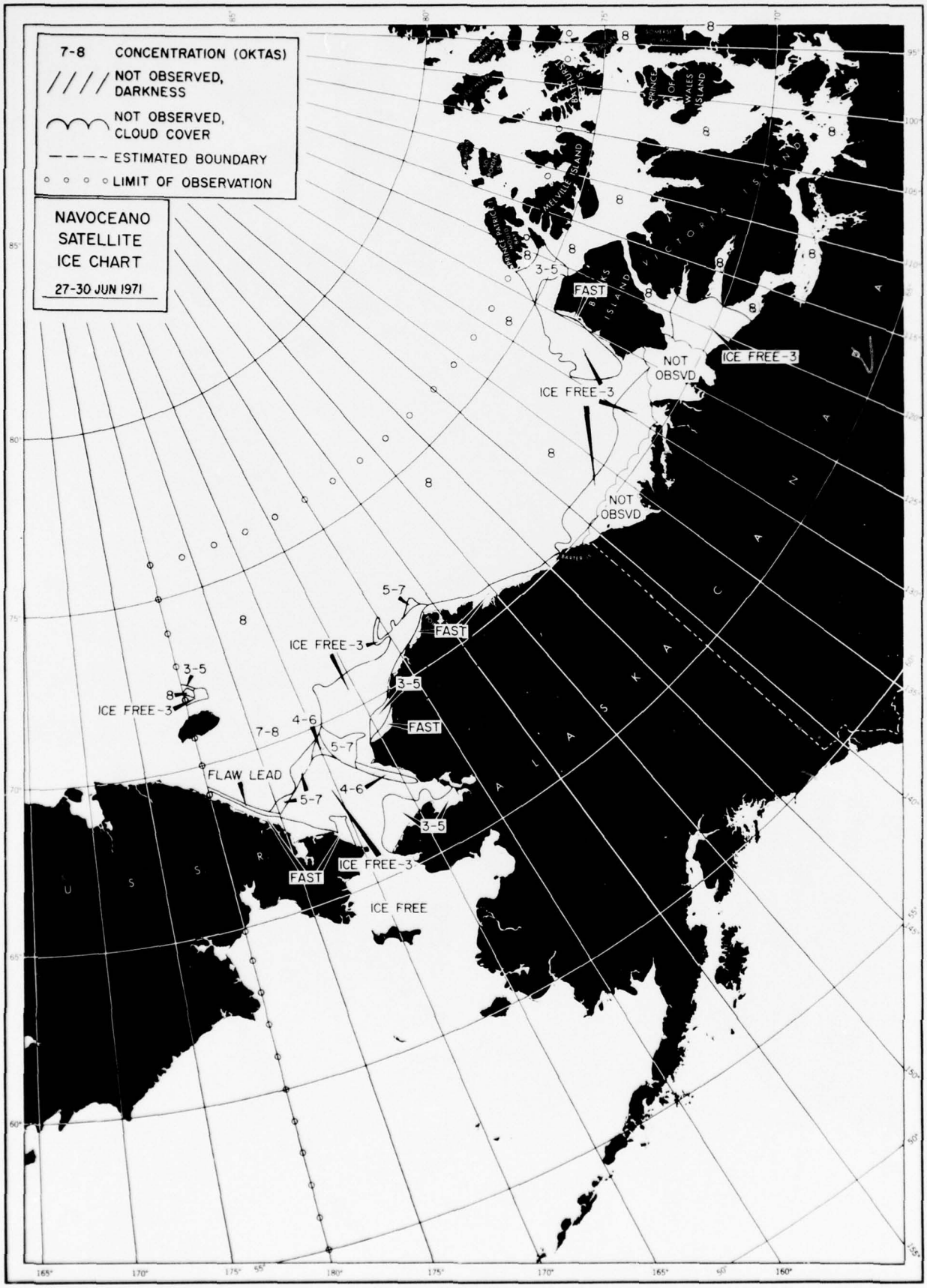
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
20-23 JUN 1971
FAST
3-5
ICE FREE-3
ICE FREE
6-8
4-6
7-8
NOT OBSVD
U S S R
A L A S K A
C A N A D A
PRINCE OF WALES ISLAND
WRANGEL ISLAND
HERALD ISLAND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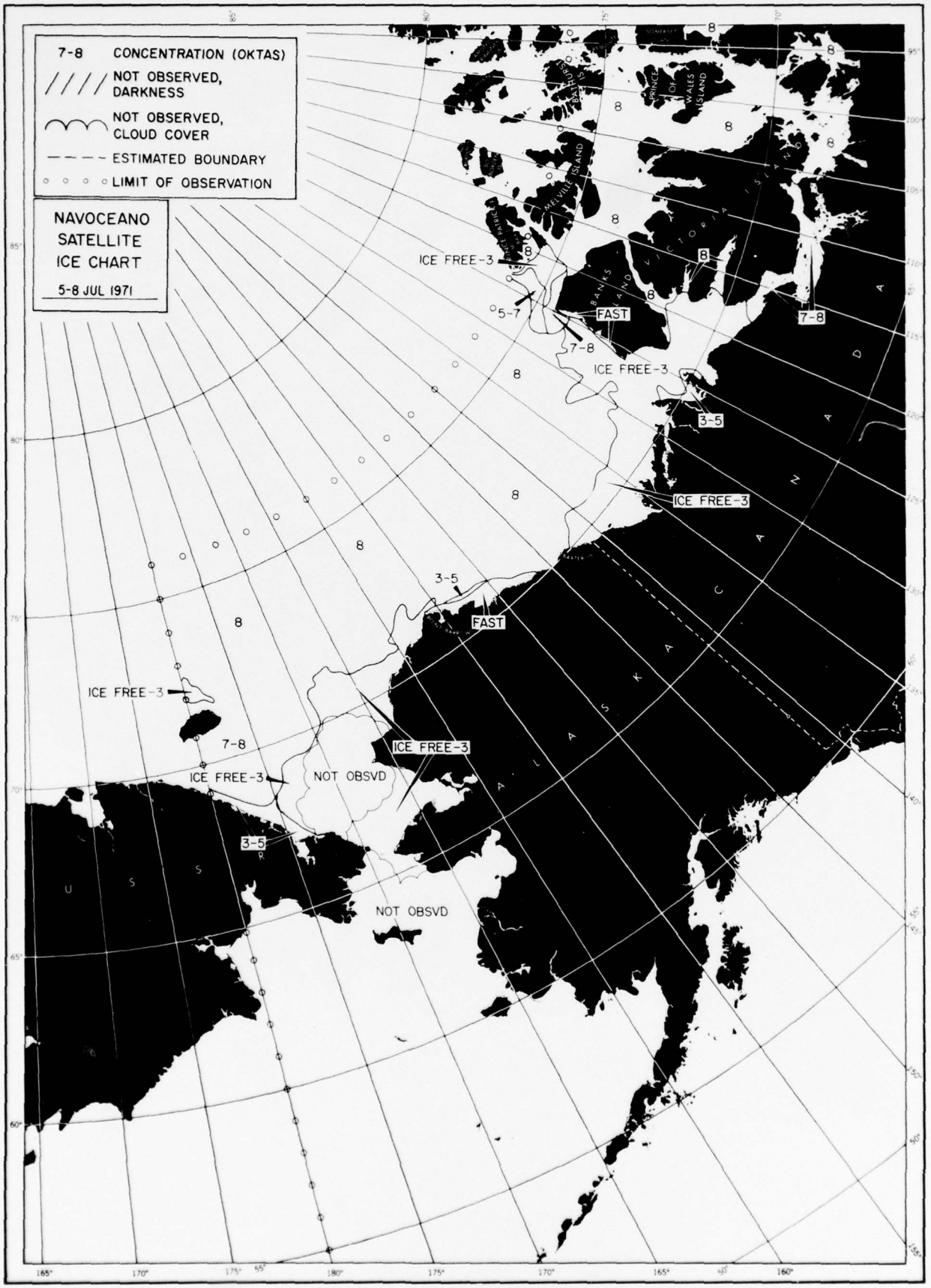
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
27-30 JUN 1971
BANKS ISLAND
VICTORIA ISLAND
PRINCE OF WALES ISLAND
MELVILLE ISLAND
PRINCE PATRICK ISLAND
CANADA
ALASKA
U S S R
FAST
ICE FREE-3
NOT OBSVD
3-5
5-7
4-6
7-8
8
FLAW LEAD
ICE FREE
160°
165°
170°
175°
180°
55°
60°
65°
70°
75°
80°
85°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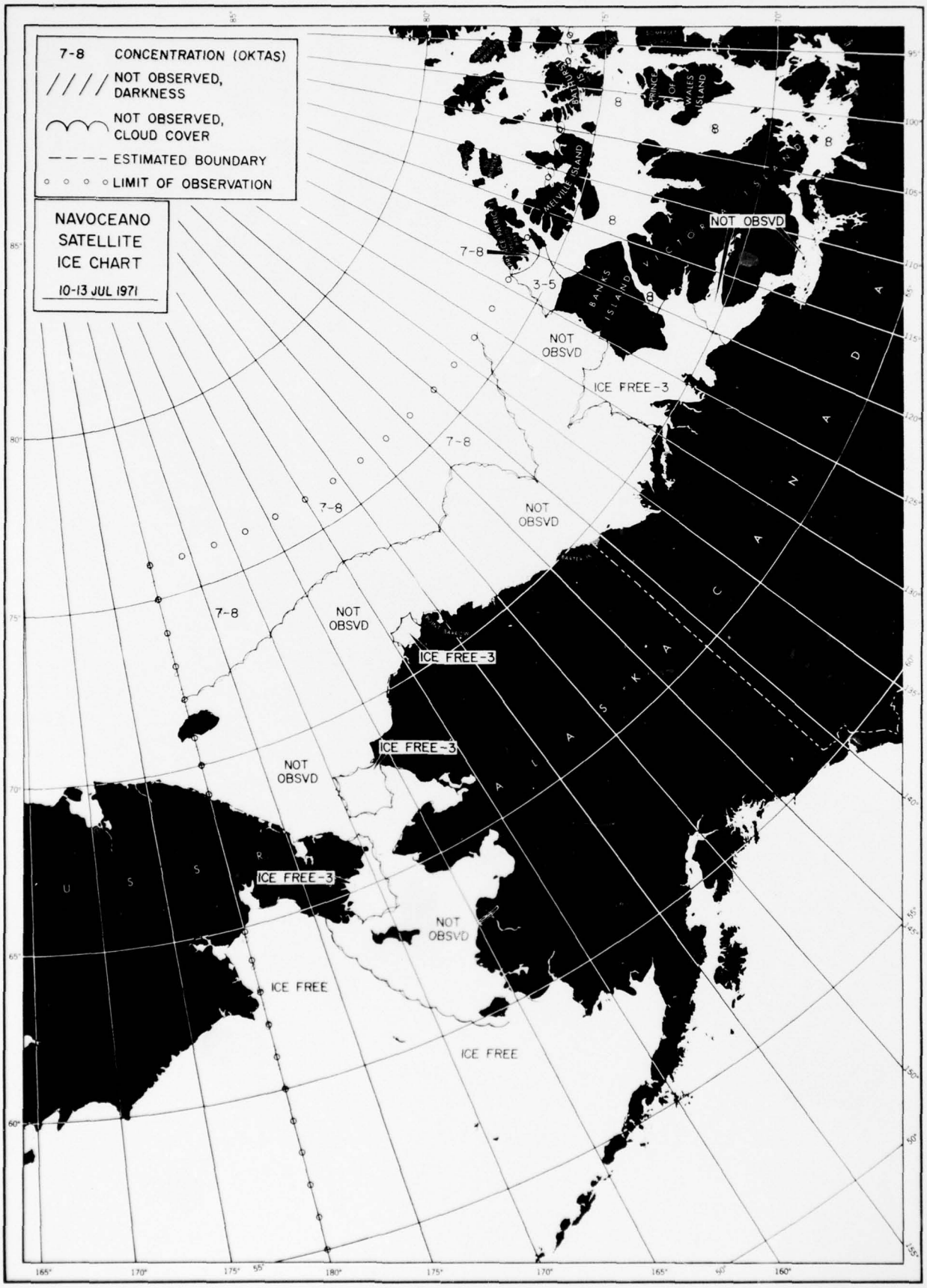
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
5-8 JUL 1971
ICE FREE-3
5-7
FAST
7-8
ICE FREE-3
3-5
ICE FREE-3
3-5
FAST
ICE FREE-3
7-8
ICE FREE-3
NOT OBSVD
ICE FREE-3
3-5
NOT OBSVD
BATHURST I.
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS AND VICTORIA ISLANDS
U S S R
A L A S K A
C A N A D A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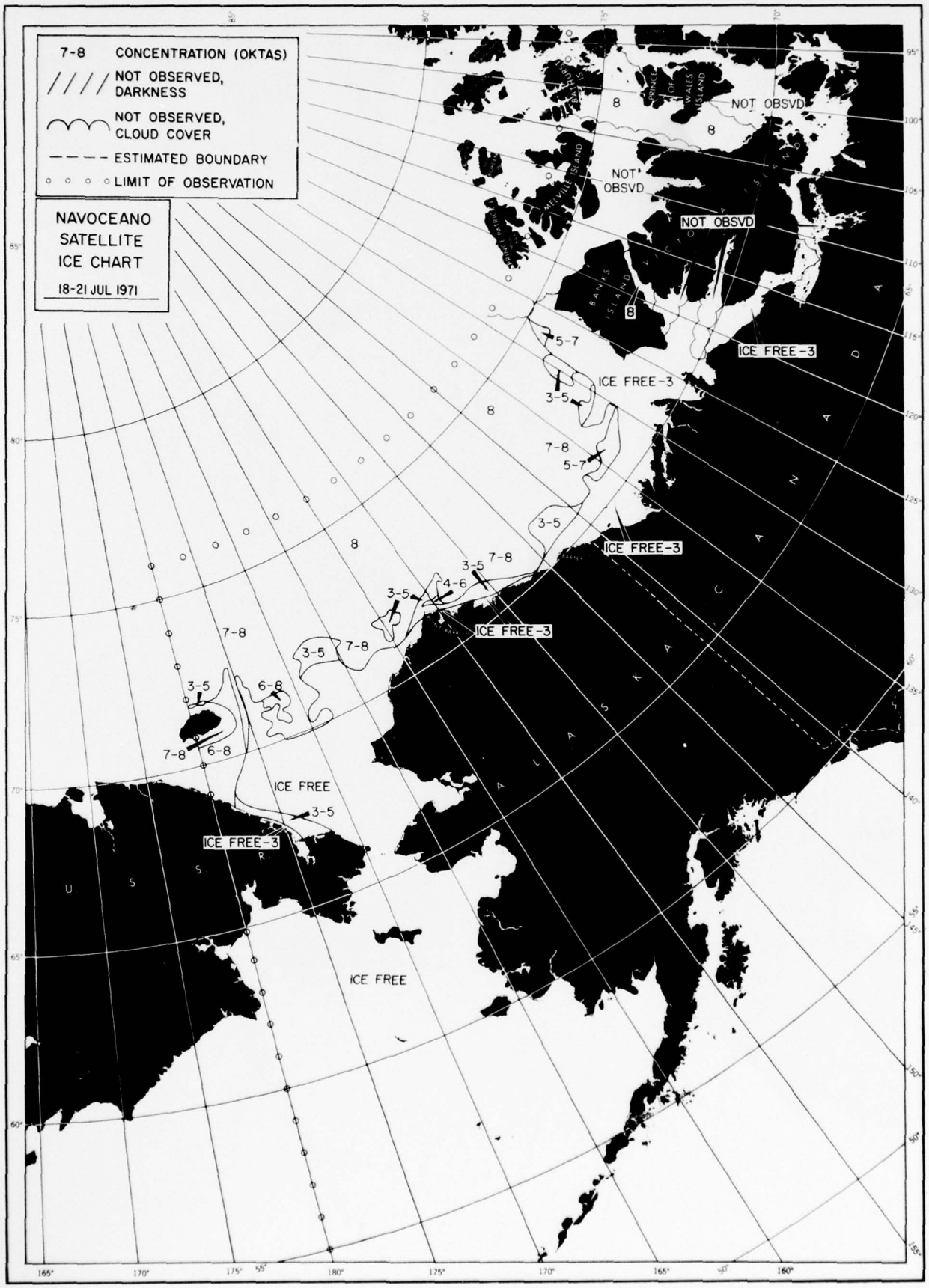
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
10-13 JUL 1971
NOT OBSVD
7-8
3-5
NOT OBSVD
ICE FREE-3
7-8
7-8
NOT OBSVD
7-8
NOT OBSVD
ICE FREE-3
ICE FREE-3
NOT OBSVD
ICE FREE-3
NOT OBSVD
ICE FREE
ICE FREE
U S S R
A L A S K A
C A N A D A
PRINCE OF WALES ISLAND
MELVILLE ISLAND
BANKS ISLAND
VICTORIA ISLAND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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
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18-21 JUL 1971
NOT OBSVD
NOT OBSVD
NOT OBSVD
ICE FREE-3
ICE FREE-3
ICE FREE-3
ICE FREE-3
ICE FREE-3
ICE FREE
ICE FREE
8
5-7
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7-8
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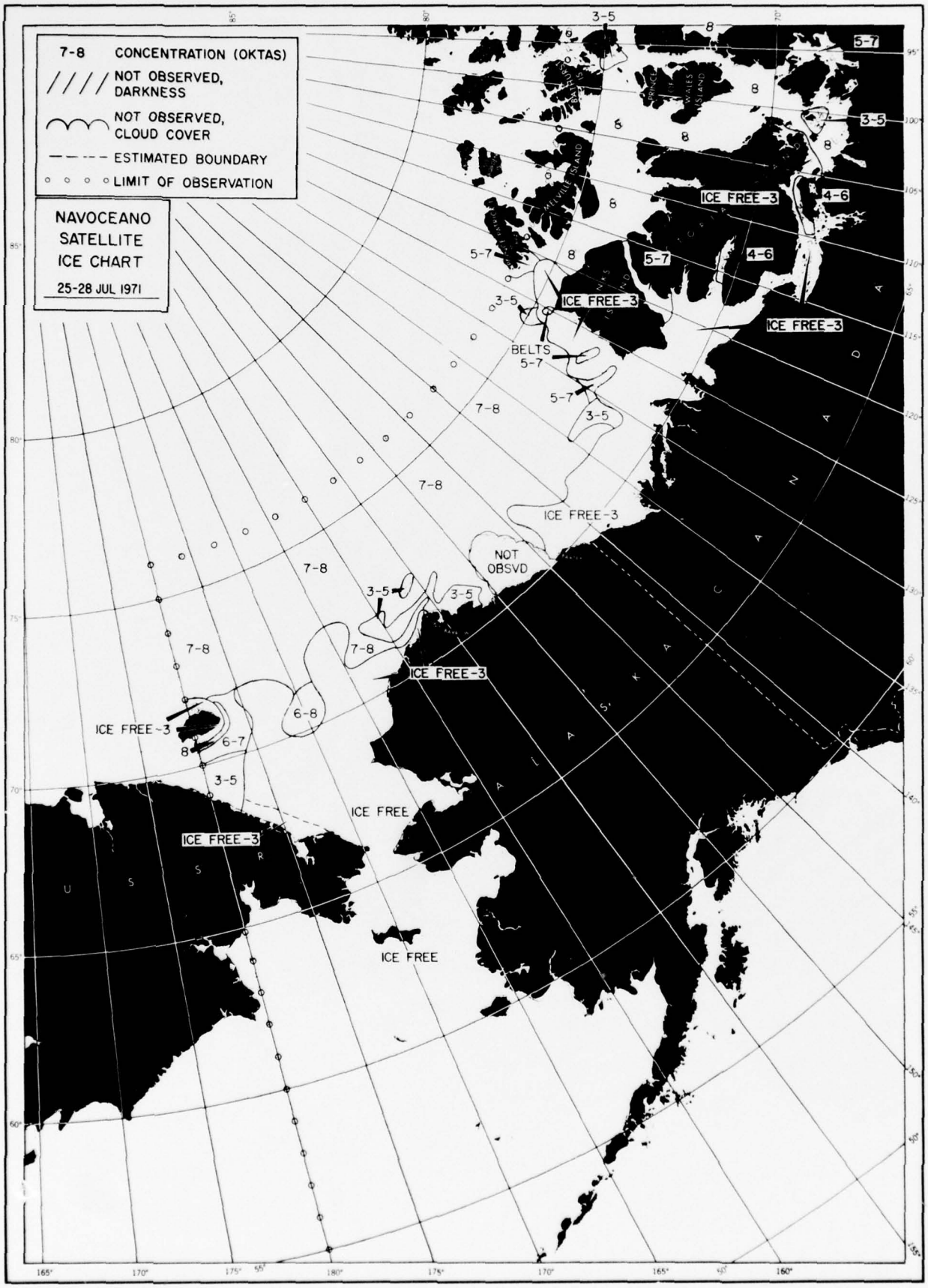
PRINCE OF WALES ISLAND
MELVILLE ISLAND
CANADA
ALASKA
U S S R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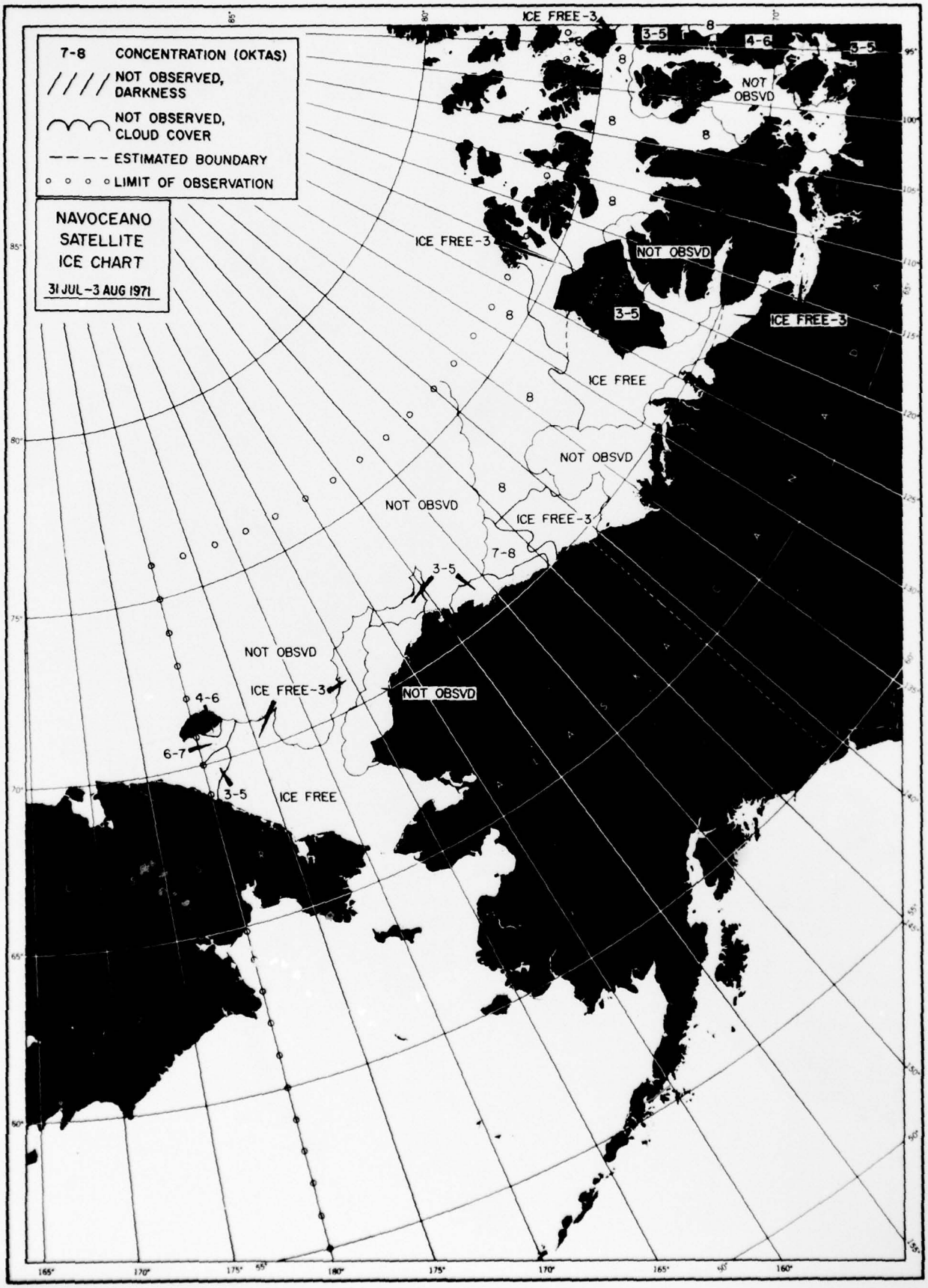
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
25-28 JUL 1971
ICE FREE-3
ICE FREE
BELTS
NOT OBSVD
7-8
6-8
6-7
5-7
4-6
3-5
BANKS ISLAND
MELVILLE ISLAND
PRINCE OF WALES ISLAND
CANADA
ALASKA
U S S R


7-8 CONCENTRATION (OKTAS)
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
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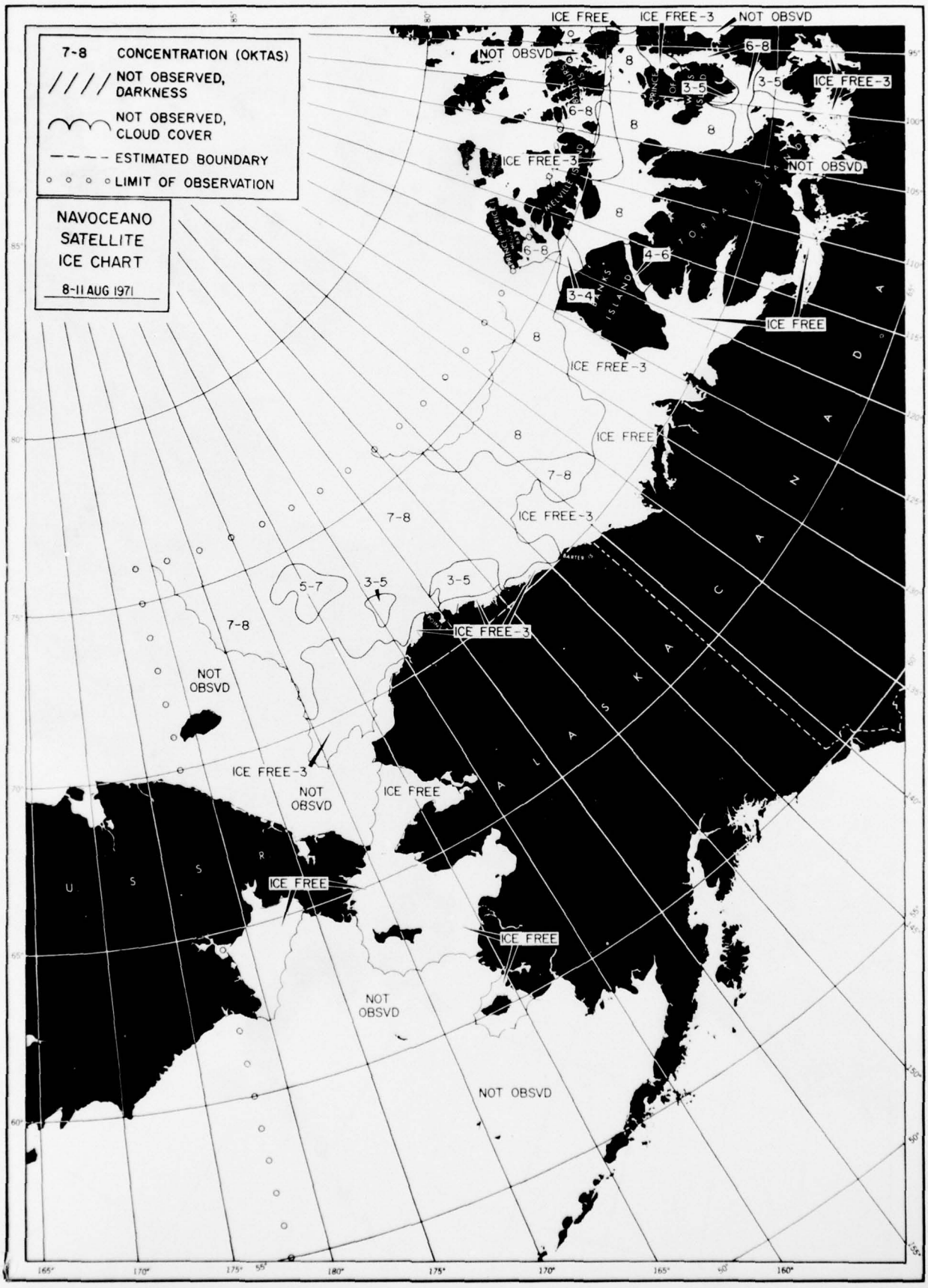
3-5
8
4-6
NOT OBSVD
ICE FREE
7-8
6-7


7-8 CONCENTRATION (OKTAS)
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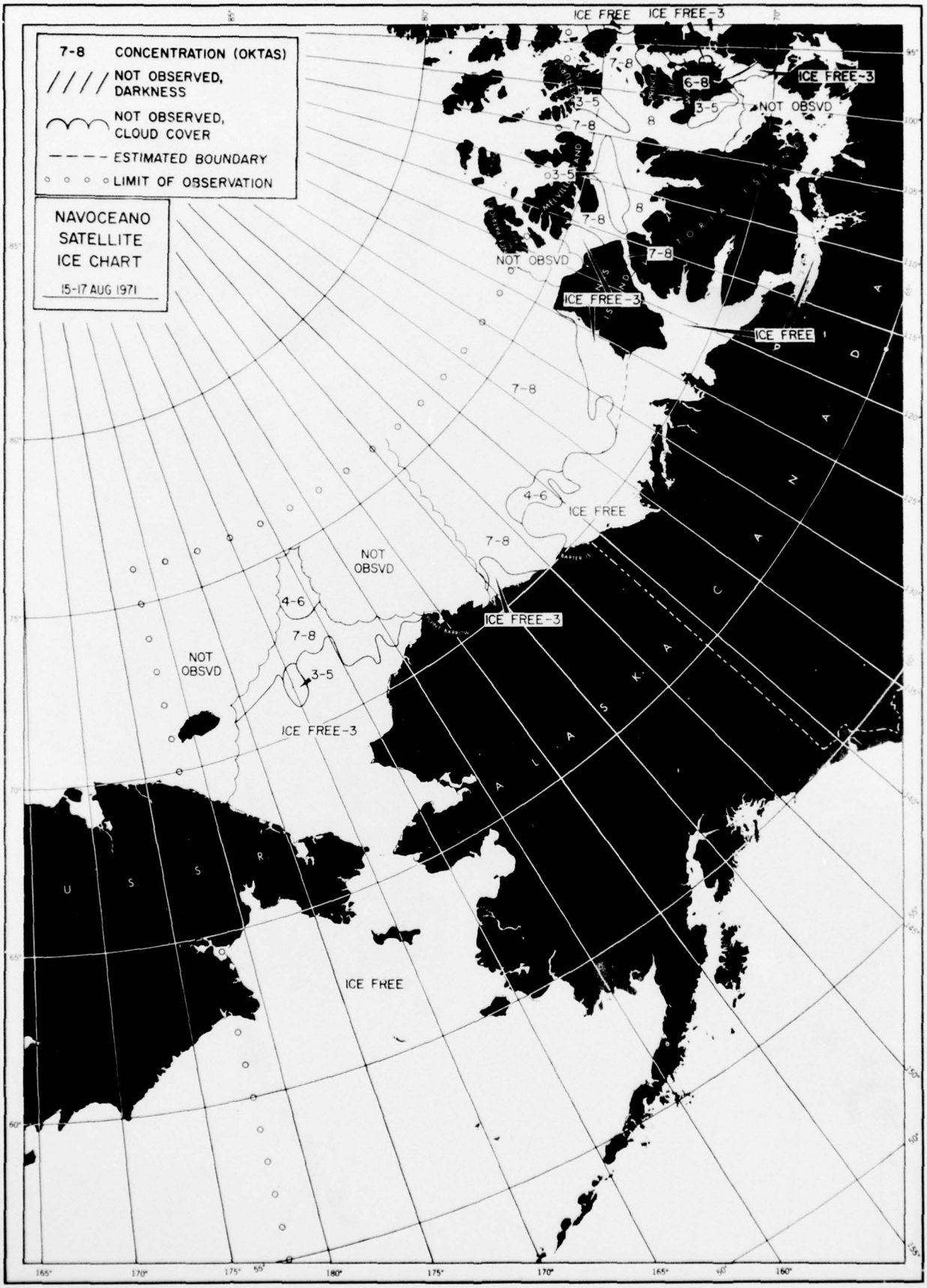
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
8-11 AUG 1971
ICE FREE
ICE FREE-3
NOT OBSVD
6-8
3-5
4-6
3-4
7-8
5-7
8
U S S R
A L A S K A
C A N A D A
PRINCE OF WALES I.
MELVILLE I.
PRINCE PATRICK I.
VICTORIA I.
BANKS ISLAND
165°
170°
175°
180°
55°
60°


7-8 CONCENTRATION (OKTAS)
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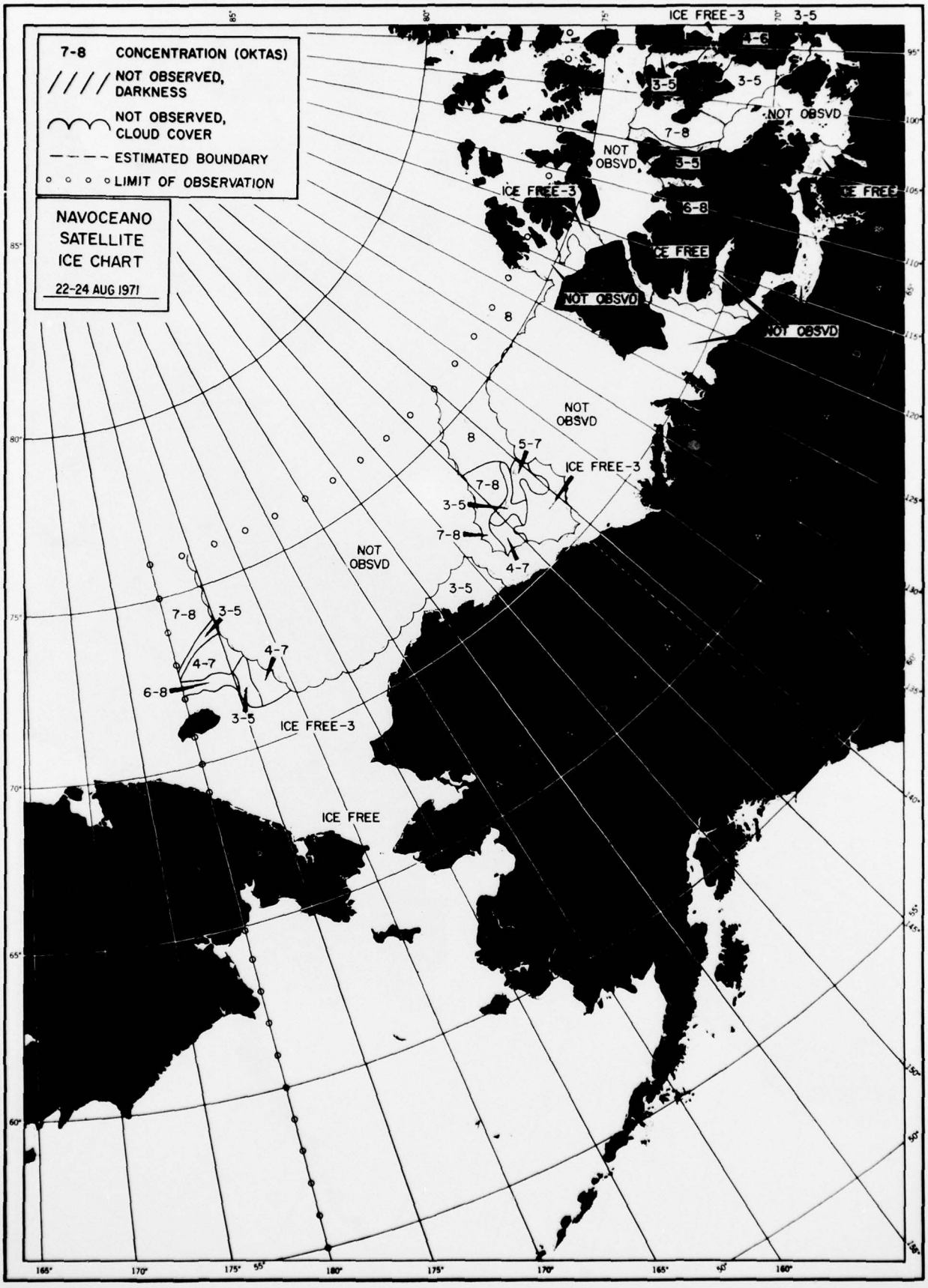
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
15-17 AUG 1971
ICE FREE
ICE FREE-3
NOT OBSVD
ICE FREE
U S S R
A L A S K A
C A N A D A
ICE FREE
165°
170°
175°
180°
175°
170°
165°
160°


7-8 CONCENTRATION (OKTAS)
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
22-24 AUG 1971
ICE FREE-3
3-5
NOT OBSVD
7-8
6-8
ICE FREE
5-7
4-7
8
ICE FREE
85°
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75°
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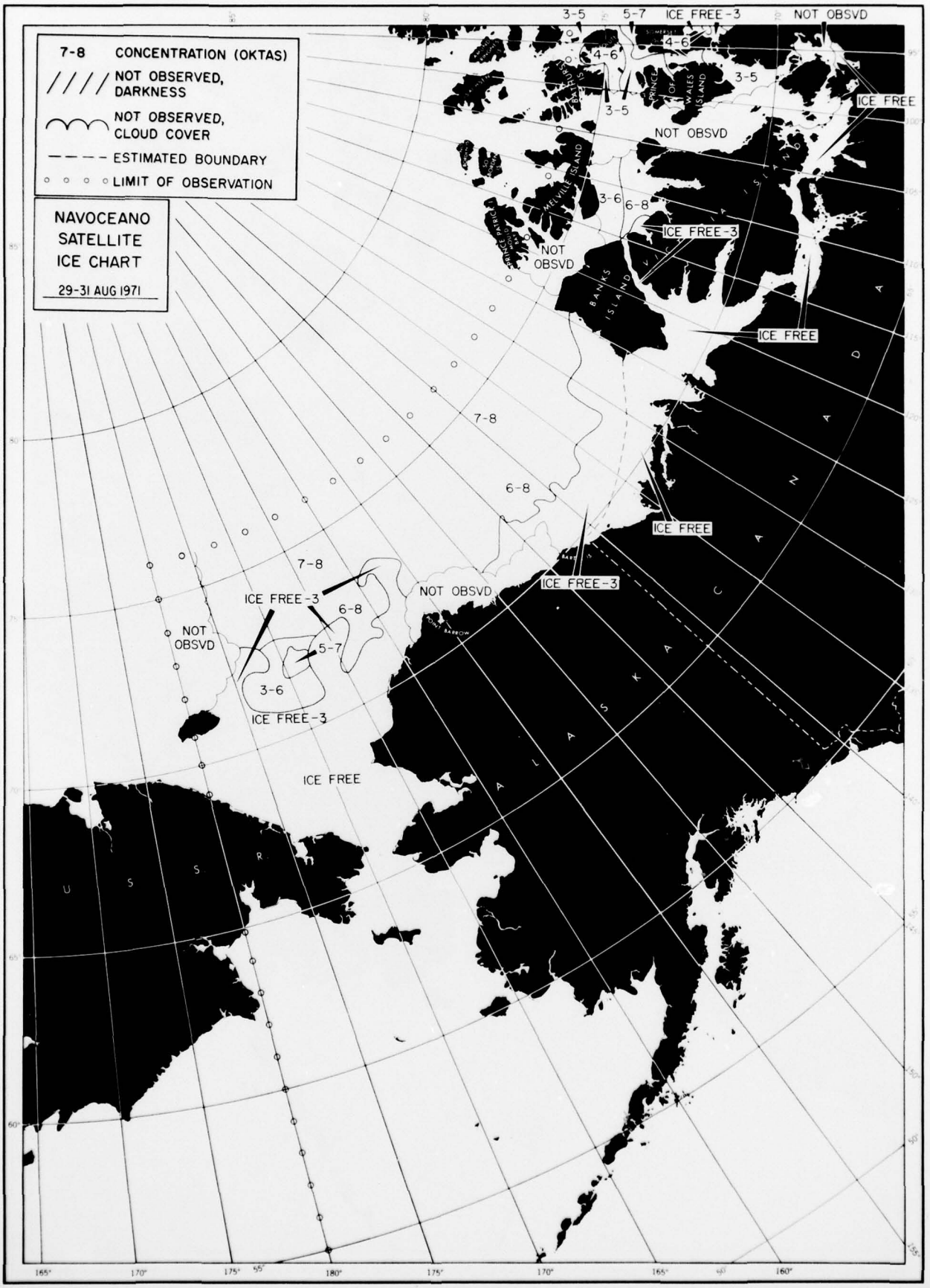
7-8 CONCENTRATION (OKTAS)
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NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
29-31 AUG 1971
3-5
5-7
ICE FREE-3
NOT OBSVD
4-6
3-5
ICE FREE
NOT OBSVD
3-6
6-8
ICE FREE-3
NOT OBSVD
ICE FREE
7-8
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ICE FREE
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ICE FREE-3
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NOT OBSVD
ICE FREE-3
NOT OBSVD
5-7
3-6
ICE FREE-3
ICE FREE
U S S R
A L A S K A
C A N A D A
MELVILLE ISLAND
BANKS ISLAND
PRINCE OF WALES ISLAND
BARROW
165°
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175°
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175°
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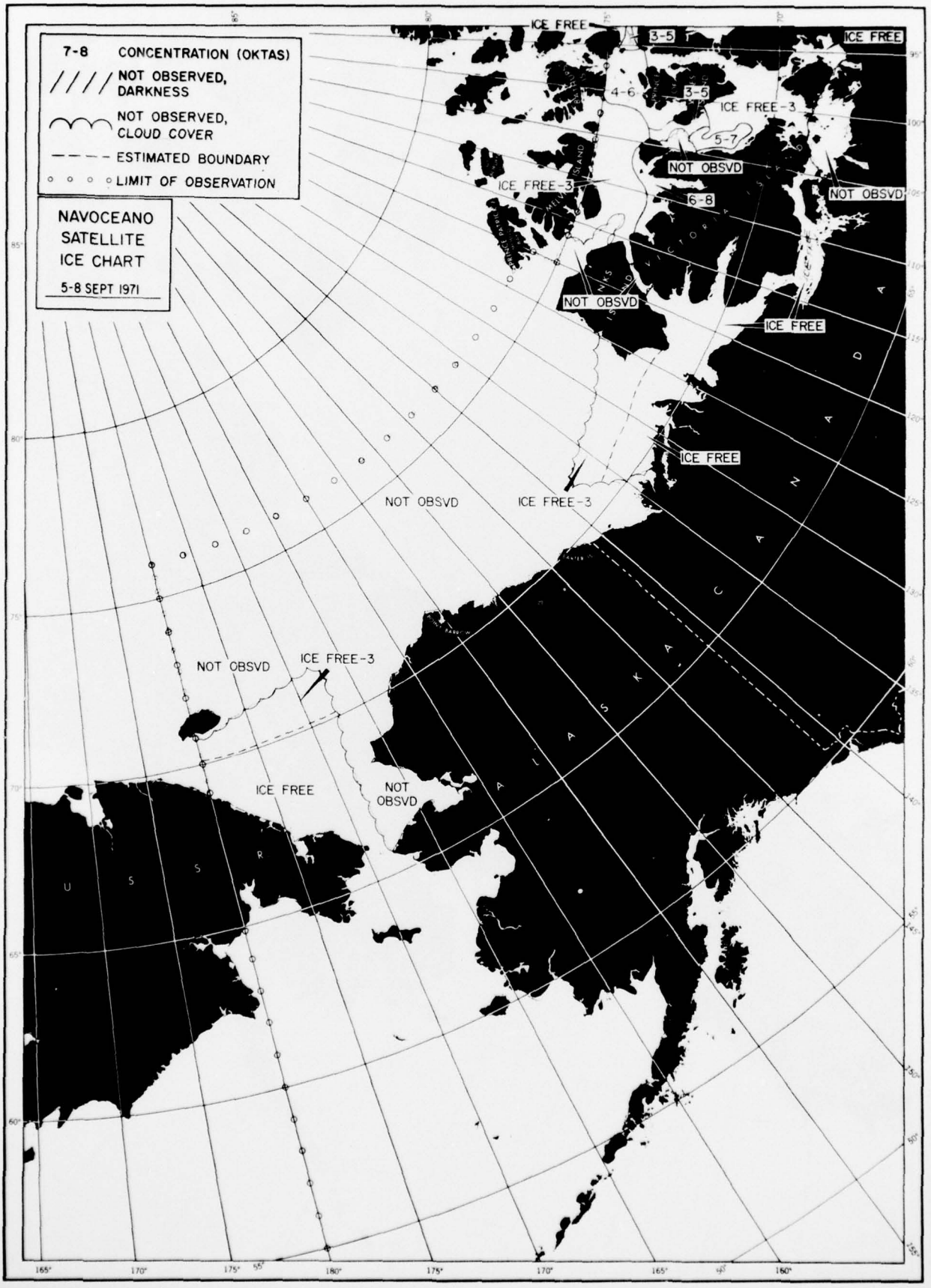
7-8 CONCENTRATION (OKTAS)
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ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
5-8 SEPT 1971
ICE FREE
3-5
4-6
5-7
6-8
ICE FREE-3
NOT OBSVD
MELVILLE ISLAND
PRINCE PATRICK ISLAND
VICTORIA ISLAND
CANADA
ALASKA
U S S R
165°
170°
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180°
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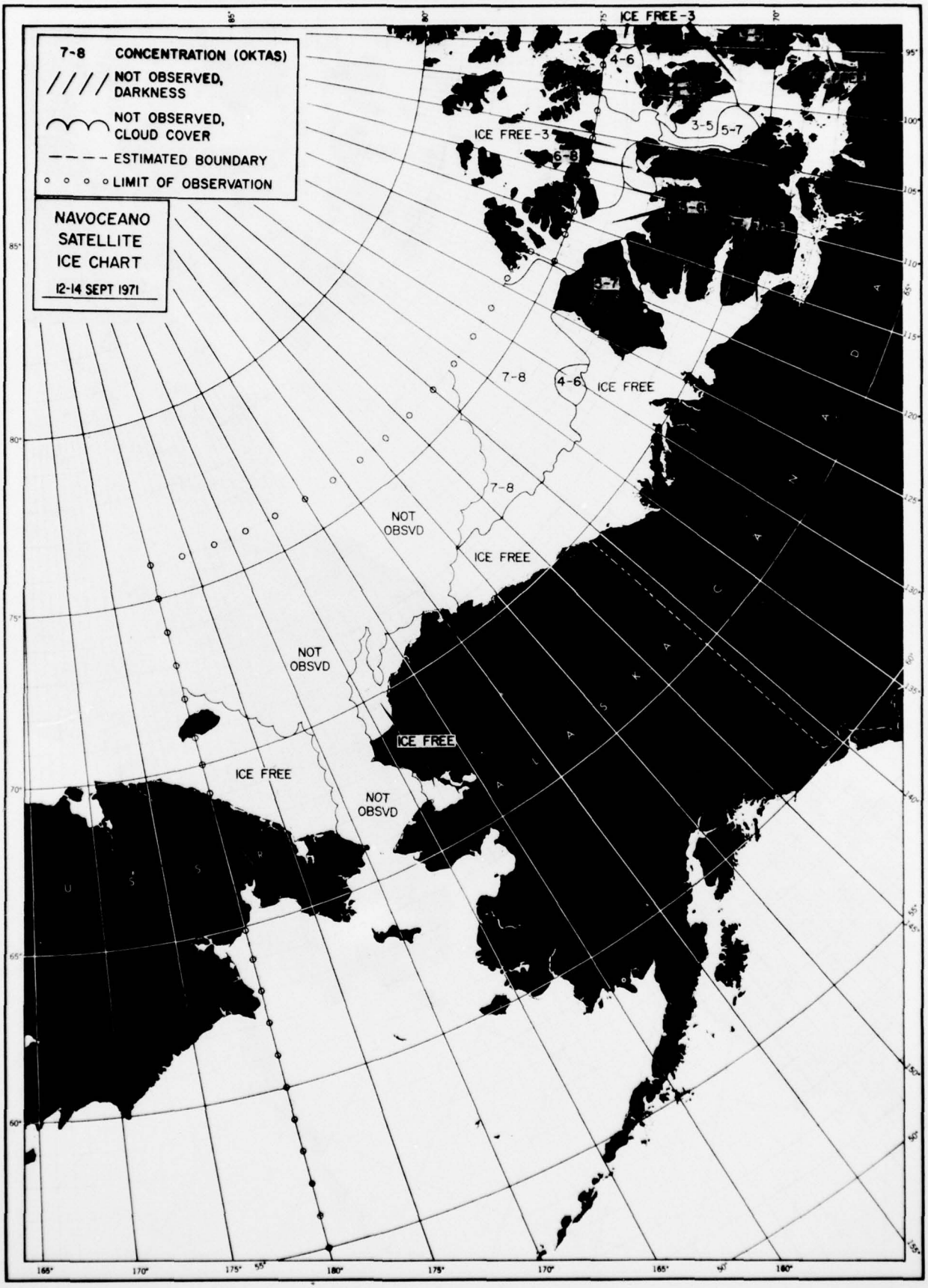
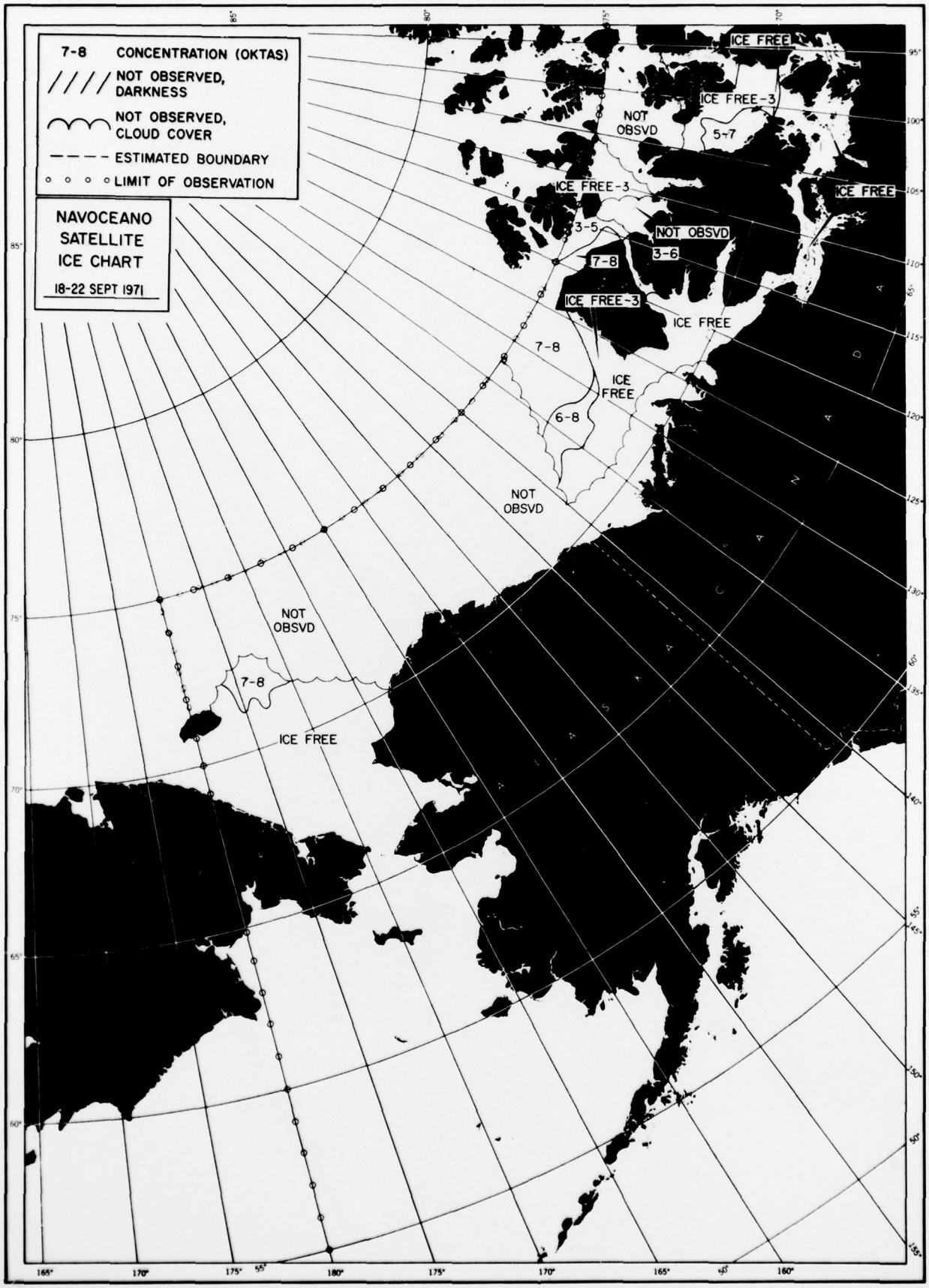

7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
12-14 SEPT 1971
ICE FREE-3
4-6
3-5
5-7
ICE FREE-3
6-8
7-8
4-6
ICE FREE
7-8
NOT OBSVD
ICE FREE
NOT OBSVD
ICE FREE
ICE FREE
NOT OBSVD
U S S R
A L A S K A
C A N A D A


7-8 CONCENTRATION (OKTAS)
//// NOT OBSERVED, DARKNESS
NOT OBSERVED, CLOUD COVER
ESTIMATED BOUNDARY
LIMIT OF OBSERVATION
NAVOCEANO SATELLITE ICE CHART
18-22 SEPT 1971
ICE FREE
ICE FREE-3
NOT OBSVD
5-7
ICE FREE-3
ICE FREE
3-5
NOT OBSVD
7-8
3-6
ICE FREE-3
ICE FREE
7-8
ICE FREE
6-8
NOT OBSVD
NOT OBSVD
7-8
ICE FREE
CANADA
ALASKA

APPENDIX E

PROJECT BIRDS EYE MISSIONS 6-71 AND 7-71

ICE CHARTS

KEY TO ICE SYMBOLS USED IN PLOTTING ICE FEATURES

TOTAL CONCENTRATION

- Ice free
- <1 okta* (open water)
- 1-<3 oktas (very open pack)
- 3-<6 oktas (open pack)
- 6-<7 oktas (close pack)
- 7-<8 oktas (very close pack)
- 8 oktas (compact pack)

CONC = Concentration
CRK = Crack
CRKS = Cracks
FRCT = Fracture
FRCTV = Very Small Fracture
FRCTS = Small Fracture
FRCTM = Medium Fracture
FRCTL = Large Fracture
LVL = Level Ice
NDTR = Not Determined
NOPG = No Openings in Ice
OPWR = Open Water
SCTD = Scattered
SD = Snow Depth
T = Ice Thickness

COVERAGE BY SIZE

$$\frac{C}{n_1 n_2 n_3}$$

C = total concentration

n_1
- SS/NL = New Ice or Nilas
- PK = Pancake <3 m
- CK = Brash, Small Cake, Cake <20 m

n_2
- SF = Small Floe 20—100 m
- MF = Medium Floe 100—500 m

n_3
- BF = Big Floe 500—2000 m
- VF = Vast Floe 2—10 km
- GF = Giant Floe >10 km
- Fast = Fast Ice

Example:
- 7 = total concentration
- 1 = okta all pancake ice
- 124 = oktas small and medium ice floes
- PK = oktas big, vast, and giant ice floes

STAGE OF DEVELOPMENT

$$\frac{A}{\text{oktas predominant, oktas secondary}}$$

AGE	AVERAGE THICKNESS
SS = Frazil, Grease, Slush, Shuga	
NL = Ice Rind, Dark Nilas, Light Nilas	<5—10 cm
G = Gray	10—15 cm
GW = Gray-White	15—30 cm
FL = Thin First-Year	30—70 cm
FM = Medium First-Year	70—120 cm
FT = Thick First-Year	>120 cm
SY = Second-Year	
MY = Multi-Year	

Example: $\frac{A}{5FM3G}$

A = Stage of development
5FM = 5 oktas Medium First-Year
3G = 3 oktas Gray

*One okta equals one-eighth ice concentration

TOPOGRAPHY

- Rafted or Finger-Rafted Ice
- Hummocks
- (N) New Ridges
- (W) Weathered Ridges
- (V) Very Weathered Ridges
- (A) Aged Ridges
- (C) Consolidated Ridges

Example: $\frac{\text{(N) (h)}}{\text{(n)}}$

(h) height of ridges in meters
(n) tenths coverage on ice

STAGE OF MELTING

FPD = Few Puddles
MPD = Many Puddles
FTH = Few Thaw Holes
MTH = Many Thaw Holes
DRI = Dried Ice
ROT = Rotten Ice
FLO = Flooded Ice

UNDERCAST

- Limit

THICKNESS OF ICE & SNOW

t_E = ice thickness in cm
s = snow depth in cm

PHENOMENA

- crack
- fracture
- polynya
- lead
- (n) icebergs
- (n) bergy bits & growlers

(n) = number in area

ICE EDGE

- observed
- radar
- limit of observed data
- satellite data

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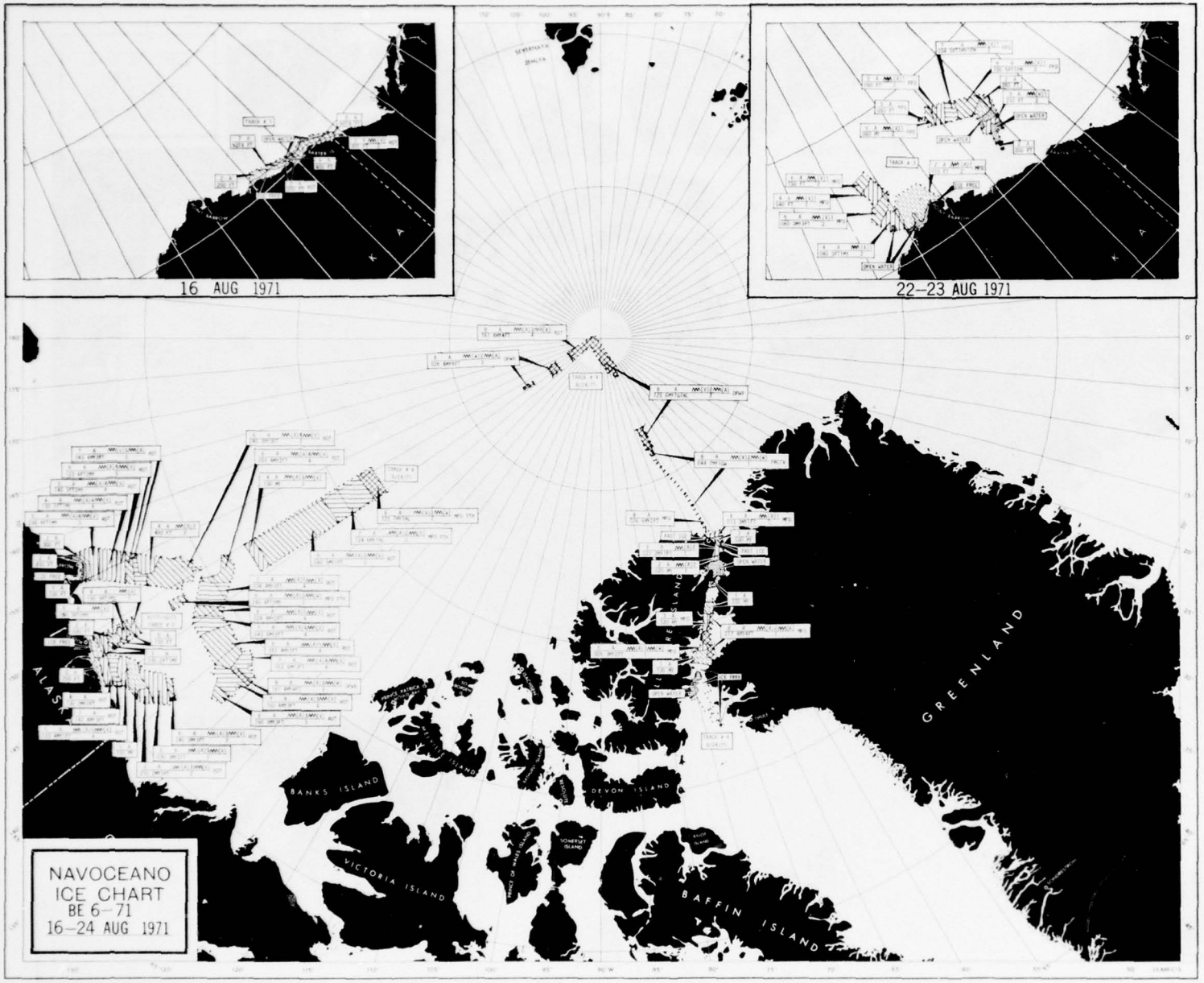
(For convenience, use fold out Key to Ice Symbols on page 12.)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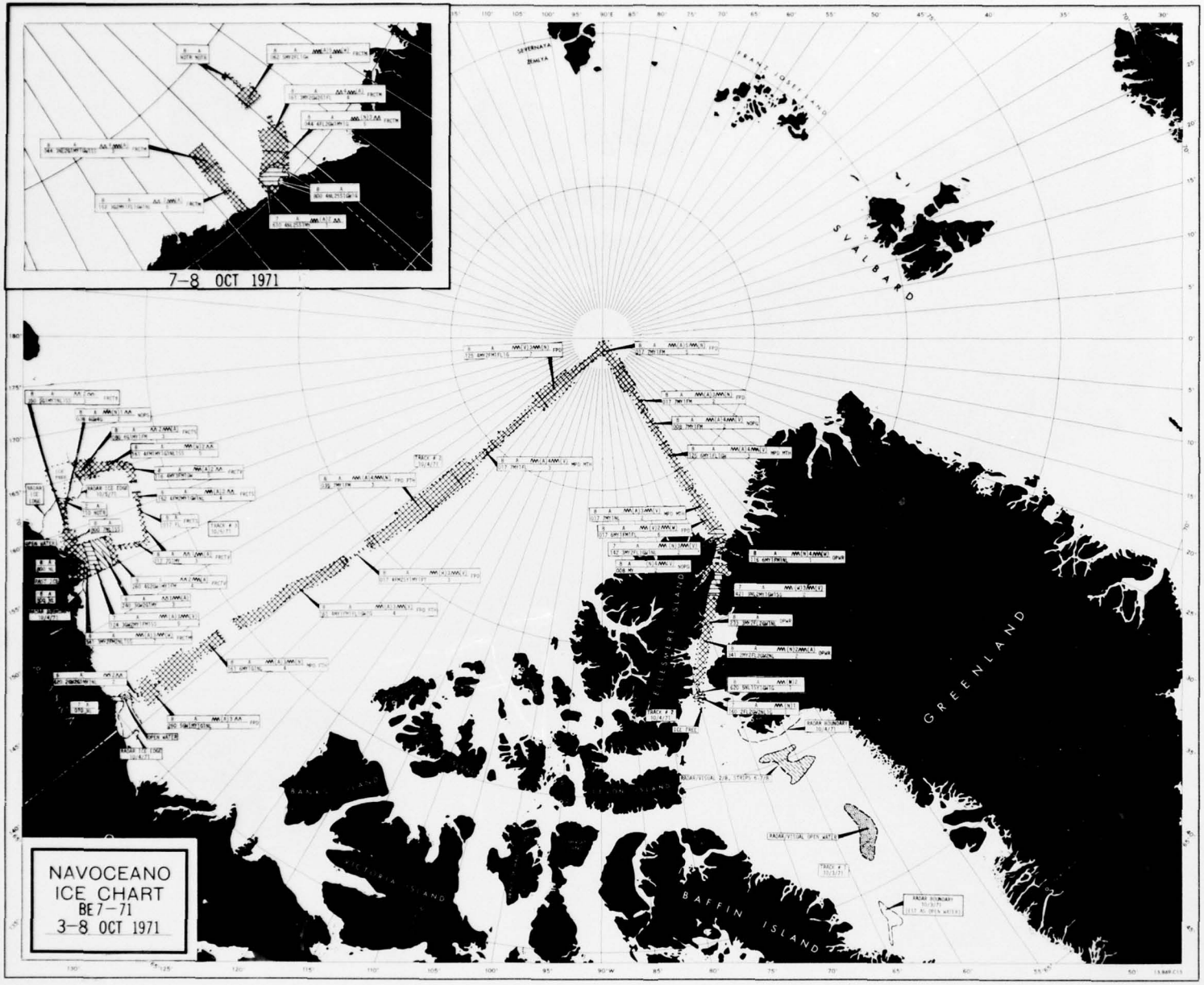
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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Ice Distribution - Arctic
Ice Forecasting - Arctic
Ice Observation - Arctic
Ice Observation - Satellite
Oceanography - Arctic
Project BIRDSEYE

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The ice program conducted during 1971 in the North American Arctic by the Naval Oceanographic Office is presented. Methods of collection and dissemination of ice data, ice forecasting, forecast verification, and interpretation of satellite ice observations are discussed. Sea ice distribution in the eastern Arctic was generally normal or slightly heavier than normal. Expected dates for escorted and unescorted entry into 5 selected eastern arctic ports were forecasted. Conditions for escorted entry into 3 of these ports occurred

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as predicted. Escorted entry at the 2 remaining ports occurred 1 to 9 days later than forecast. Conditions for unescorted entry also occurred as predicted at 3 of these ports. Unescorted entry was possible 6 days later than forecast at one port and 20 days earlier than forecast at the fifth port. Ice conditions in the western Arctic were heavier than normal for the third consecutive year, especially in the Bering Sea during spring. Ice conditions, based on aerial and satellite data in the eastern and western sectors of the Arctic and data observed over the Arctic Basin during 2 BIRDSEYE missions, are shown graphically in separate appendixes.